SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE LOST ARTS OF CHEMISTRY[1]

IN addition to chronicling past and present events merely, it pleases the historian from time to time to ascertain, as nearly as he can, by a comparison of present with past conditions and present knowledge and practise with past knowledge and practise, the present condition of mankind of any particular society, in comparison with past conditions. Thus are compared present systems of government with past systems, new religious beliefs with old, modern science with ancient science, present-day arts and manufactures with those of old.

Progress never takes a straight course for any considerable length of time. Nor does it even follow an undulating course in one general direction. But there are advancements and retrogressions, repeated endlessly. And again progress as recorded by history does not represent necessarily the progress of the whole human race. On the contrary, it does not represent even a large part of the human race, but at most an isolated portion of it, and in this isolated portion the progress is recorded not of the whole but of the most advanced individuals only. When we say that the present age is one of great business, scientific and manufacturing or artistic achievements in comparison with the fourteenth century, for example, we mean that a few individuals, very few in fact compared with the total number, have contrived to bring about great results in those fields of human activity. But we must remember at the same time that the majority of indi-

[1] An address delivered before the Minneapolis meeting of the American Chemical Society, December 28, 1910.

viduals may not have been directly concerned in the advance or may not have contributed directly to it at all. Indeed, it seems as though the lowest members of the human race to-day are no farther advanced mentally than were their progenitors in recent geologic times. Even with rapid progress of the most favored or most enterprising individuals there may be little progress or none in the case of the average of mankind. It is not unlikely that at the present day the intellectual gap between the mentally highest and lowest of mankind is greater than at any previous time.

In spite of the high intellectual and practical standard reached by the leading men of to-day, from another point of view (called by some the pessimistic) the outlook to-day is far from satisfactory in politics, religion, manufacture or science. Whether we consider our all but failing efforts at democracy in the United States or the vacillating and undirected religious tendencies of the people (as shown by mormonism, seventh day adventism, dowieism, christian science, the old theologies or the strange oriental doctrines and ideals of the majority of our people, which fortunately are scarcely put into practise); or if we consider the slow conservatism and plodding course of manufacture and business, including our great untouched problem of the economic distribution of goods, we can not fail to be impressed with the length of the journey which we must sooner or later take, on the road of development.

But we may turn from the rather unsatisfactory consideration of politics, religion and business to the consideration of modern science with a rare degree of satisfaction and enthusiasm. There, at least, progress is visible, tangible or even obtrusive. There, at least, the forward movement does not take the slow, conservative, timid pace of business, nor follow the meandering, uncertain, sentimental path of religion, or the crude meaningless way of politics. In that field at least the way is certain, the methods positive, the results satisfying, the application secure and the progress lively. Considered by itself, science and the scientific method are the most satisfactory and satisfying things in the possession of the human mind. The unfortunate thing—it can not be classed as a criticism—about science is that it has left the multitude untouched. With the results of science and the scientific method on every hand forming so large a part of our splendid materialistic civilization, nevertheless the great, the overwhelming majority of people are ignorant of the methods, the aims and the results of scientific inquiry in daily use, and of daily necessity. Of even greater import, the scientific method of thought is not a part of their mental equipment.

Science and the scientific method have their critics, no less than other excellent things. Science is unmoral, cold, heartless, pessimistic, hopeless, often cruel in method, say they. The scientific inquirer can well afford to let most of such accusations as these go unchallenged. But there is one statement which has been sown broadcast, which springs up in a thousand unexpected places, and which it is worth while to devote some attention to in order to refute it. It is the statement that ancient peoples have been possessed of knowledge and of arts unknown to modern times; and indeed people would have us believe that this knowledge and these arts are recoverable by us if at all only with extreme difficulty. The "lost arts" is the cry. In so far as these so-called lost arts concern applied chemistry let us examine into them, and ascertain if posible whether or not there is truth in the assertions alluded to.

In the first place we may well inquire into the origin of the wide-spread belief that the knowledge of various mechanical and chemical arts has been lost to mankind. Probably first among the causes is that universal veneration of antiquity which makes gods and saints out of heroes and martyrs of the past, leads to ancestor worship and in general exaggerates the virtues, the crafts and the deeds of valor of olden times. Secondly, the delight of many persons in mystery, their tendency toward belief in the mysterious, occult and miraculous, against their better judgment and the facts in the case, have great influence in originating and perpetuating the belief in lost arts. Thirdly, among the more general causes, we may place vague statements or sentences which we can not accurately translate in ancient manuscripts. Fourthly, the natural reaction against an egotistical age. Fifthly, the use by ancient peoples for certain purposes of materials which we would not use to-day on account of their unsuitability. This leads to the conclusion that the ancients knew of different and better methods of preparing the material. Sixth, it has pleased certain writers and lecturers to insist strongly upon the point that there have been at various times in existence arts no longer known and used. One finds brief statements in various books of such import as "they knew how to harden copper." "Their mortar outlasted the stone it cemented." "The degree of perfection they reached in enameling has never since been attained," etc. In America the man who has had probably more effect than others in this respect was Wendell Phillips. His lecture entitled "The Lost Arts" was first delivered in the American lyceum course in the winter of 1838. During succeeding years the lecture was repeated about two thousand times and was heard by all sorts of audiences throughout the country and at the time and subsequently made a great impression. Many persons now living still remember the famous lecture. It is difficult to read this lecture to-day and believe that it was seriously intended in certain places by Wendell Phillips; yet I am assured by several individuals who heard it that, although illumined by humor in places, it was, as a whole, seriously intended and received. In various lectures Phillips committed many sins against accuracy and truth, but in none more than in the "Lost Arts." He misquoted Pliny in regard to his statements about the origin of glass manufacture—a tale familiar to you all and hardly rising to the dignity of a first-class fable. And of all authors, Pliny can least afford to be misquoted; being already overburdened with inaccuracy and unreliability. Let me present a few brief quotations from this remarkable lecture.

> The chemistry of the most ancient period had reached a point which we have never even approached, and which we in vain struggle to reach to-day. Indeed, the whole management of the effect of light on glass is still a matter of profound study.
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> The second story of half a dozen—certainly five—related to the age of Tiberius, the time of Saint Paul, and tells of a Roman who had been banished, and who returned to Rome, bringing a wonderful cup. This cup he dashed upon the marble pavement, and it was crushed, not broken, by the fall. It was dented some, and with a hammer he easily brought it into shape again. It was brilliant, transparent, but not brittle. I had a wineglass when I made this talk in New Haven; and among the audience was the owner, Professor Silliman. He was kind enough to come to the platform when I had ended, and say that he was familiar with most of my facts; but speaking of malleable glass, he had this to say—that it was nearly a natural impossibility, and that no amount of evidence which could be brought would make him credit it. Well, the Romans got their chemistry from the Arabians; they brought it into Spain eight centuries ago, and in their books of that age they claim that they got from the

Arabians malleable glass. There is a kind of glass spoken of there that, if supported by one end, by its own weight in twenty hours would dwindle down to a fine line, and that you could curve it around your wrist.

Cicero said that he had seen the entire "Iliad," which is a poem as large as the New Testament, written on a skin so that it could be rolled up in the compass of a nut-shell. Now, this is imperceptible to the ordinary eye. You have seen the Declaration of Independence in the compass of a quarter of a dollar, written with glasses. I have to-day a paper at home, as long as half my hand, on which was photographed the whole contents of a London newspaper. It was put under a dove's wing and sent into Paris, where they enlarged it and read the news. This copy of the "Iliad" must have been made by some such process.

Pliny says that Nero the tyrant had a ring with a gem in it, which he looked through, and watched the sword play of the gladiators—men who killed each other to amuse the people—more clearly than with the naked eye. So Nero had an opera-glass.

So Mauritius the Sicilian stood on the promontory of his island and could sweep over the entire sea to the coast of Africa with his nauscopite, which is a word derived from two Greek words, meaning "to see a ship." Evidently Mauritius, who was a pirate, had a marine telescope.

The French who went to Egypt with Napoleon said that all the colors were perfect except the greenish-white, which is the hardest for us. They had no difficulty with the Tyrian blue. The burned city of Pompeii was a city of stucco. All the houses are stucco outside, and it is stained with Tyrian blue, the royal color of antiquity.

But you never can rely on the name of a color after a thousand years. So the Tyrian blue is almost a red—about the color of these curtains. This is a city all of red. It had been buried seventeen hundred years; and if you take a shovel now, and clear away the ashes, this color flames up upon you, a great deal richer than anything we can produce.

I feel reasonably sure from what I know of the history of science that the main points made in this lecture were not true in Wendell Phillips's time. I know they are not true to-day.

To recapitulate: the causes of a belief in lost arts appear to be the veneration of antiquity, the belief in the mysterious and occult, inaccuracies in and inaccurate readings of ancient texts, reaction against present-day egotism, the use of unsuitable materials by ancient peoples and the emphasis laid upon ancient skill by half accurate writers.

No one could wish to detract from the great, the skilful and the beautiful works of the ancients. All we can desire is a proper and clear understanding of their accomplishments.

Long before the way was prepared for an approach to chemistry as a science, many were the chemical facts known and used and many the chemical arts and manufactures which arose and flourished. The foundations of many of our greatest chemical industries were securely laid long before the science of chemistry lent its aid. The industries of cement and plaster, glass, ceramics, pigments, oils and fats, varnishes and lacquers, sugar, fermentation, textiles, paper, dyeing, leather, glue and various metallurgical industries are some of those which were very well developed before the advent of scientific chemistry. Indeed, the science of chemistry has found and still finds some of its richest materials in these very industries. What can be accomplished by patient manual skill and dexterity is amazing, and it must be conceded that the adoption of exact mechanical processes in our times has lessened the necessity for such skill in many directions. It is true also that many ancient peoples and many of the less mechanical modern ones have applied manual dexterity to their arts in such a way that we marvel at the results. But it is difficult to find a case where similar application to-day would not yield a similar result. Nothing can be considered lost unless it be the demand for and desire to produce works of a certain kind.

Again it is true that some arts and

modes of manufacture reach a stage which we may call practical perfection, relatively soon after the initial discoveries are made which give them their first impetus. After this point is reached the improvements are few or none (and if any occur, they come from an outside source, as the application of power to the loom). Examples are abundant: the hoe and other simple farming implements; the safety bicycle; the sewing machine; the aeroplane. It must, of course, be presupposed that suitable materials for manufacture have been previously discovered and are at hand, or can be quickly adapted. In such cases as these the opportunities of later generations to develop and improve are meager; but the limitation is not of the inventors, but of the things themselves.

For many years the great pyramid of Egypt was held up to the youth in all lands as an example of what had been accomplished by ancient peoples and which could not be duplicated to-day. It was held in fact that the ancient Egyptians were possessed of mechanical knowledge and appliances unknown to us. We must all concede that the great pyramid is a remarkable, if useless, piece of architecture, laid out with extreme precision and carried to its completion in a masterly way. But it turns out that the Egyptians of the Old Kingdom possessed rather limited knowledge of mechanics, not having even developed the movable pulley. The great pyramid was built by man-power multiplied many thousand times. Finally, can it be considered a greater work than a great railway system or battleship?

That arts have been temporarily lost at least for practical purposes is true. The history of industry has not yet been written—possibly it is too great a task—and adequate data have not been collected and hence are not available, but it seems true from the information available that there has been a remarkable continuity in industrial processes in spite of many adverse circumstances.

War is probably the greatest cause of breaks in the continuity of manufacturing processes and the arts of peace, and if we are to believe past records, the domination of theological systems or religious dogmatism has been and is the most effective influence in restraining the development of scientific methods of inquiry and consequently progress in the arts. On the other hand, commerce and the migrations of peoples have been effective in spreading industries. War destroys commerce, but often causes migrations, and hence has been an active influence in the spreading of industry as well as in checking it. War has also imposed new civilizations on old, and thus caused an unnatural intercourse between two civilizations, which would naturally result in the extension of knowledge of the industries peculiar to each.

Let us examine for a few moments some of the arts claimed to be now lost. The knowledge of a process for hardening copper is commonly ascribed to many ancient and prehistoric peoples and is devoutly believed in by many persons. Now in the first place if this knowledge was formerly possessed we have no direct evidence of it, for the copper implements which have come down to us are no harder than those we might make ourselves to-day. A metal may be hardened in two ways: by physical treatment or by alloying it with other metals or substances. Copper may be hardened to some extent by hammering, in the same way that many other metals may be hardened. The common alloys, bronze and brass, are harder than the pure metal. It is probable that ancient peoples used the process of hammering to harden copper and it is certain that they made use of the

alloys of copper first with tin and later with zinc, for many purposes, including tools and implements. But because copper and copper alloys were used for implements subjected to rough usage, this does not justify us in concluding that the makers had knowledge of a method for making the metal hard, durable and serviceable. The simple and direct explanation is that they had no better material for the purpose at their command, just as in the bone and stone periods bone and stone were the best materials of construction available for tools and implements. There is no justification for the idea that ancient peoples knew how to harden copper by means unknown to metallurgists of the present day.

The ceramic arts are among the oldest known to mankind and the earliest development of them will probably remain unknown to us. They had their beginnings in the bone and stone age, and were probably first practised by women, not by men. The first clay vessels may have been clay-covered baskets dried in the sun—we do not know certainly. From those early beginnings to the highest types of the art required the labor of many potters, numberless experiments and numberless failures. We class ceramics among the chemical industries, and properly so; and yet the ceramic art originated, developed and flourished in many ages and in many parts of the earth without any thought of or aid from the science of chemistry. It has always been and still is to a very large extent an empirical industry. The essential difference between the pottery practise of ancient times and the most scientific practise of modern times lies in the reproducibility of bodies and glazes by modern methods. And yet few chemists in the industry have the temerity to predict how a new clay or glaze will come out of the kiln. The potters of long ago, by countless trials of different materials and countless failures, were able to produce certain effects; and they were able to continue the manufacture of similar wares and produce similar effects so long as they were able to obtain materials from the same sources. A change of material would almost certainly mean a change in product. It must not be forgotten that this same limitation affects the ceramic industry to-day to a very large extent. The varieties and properties of clays are almost numberless. It is true that potters of all times have been able to devise certain simple tests whereby they have been able to recognize differences and similarities in their raw materials, but these tests were usually of too crude a character to make refined distinctions. Now from the very fact that ancient potters were dependent on certain sources of supply for materials to produce certain wares, it was very natural that wares made by a certain people at a certain time were not made by that people at another period, or by different peoples. And such a case would probably be classified as a lost art. But this can not properly be called a lost art. Rather it is a case of lost materials! Given the materials, the wares could be made as at first. This in fact has been the work of more recent times—to ascertain by careful analysis the nature of various bodies and glazes and reproduce them. Of course the composition is not the whole secret, the heat treatment is almost equally important, and this is a matter for careful physical testing. But as the result of modern research and practical experiment it can scarcely be maintained that any body or glaze exists which has not been and can not be reproduced.

Glass manufacture is allied to the ceramic industry, and is probably the outgrowth of it. In spite of Pliny's fable to

account for the origin of glass making, it is altogether likely that glazes and enamels were the immediate forerunners of glass. Glass manufacture had its origin in Egypt, not far from 2500 B.C. Who shall say that the natural mineral resources of the country (among them limestone, sand and alkalis) were not responsible for its origin there? It spread to the countries east and north of Egypt to Greece and Rome, to Spain, France and more recently to Saxony, Bohemia and Austria—finally over the civilized world. At the present time the data for a history of glass manufacture are probably as complete and available as that for any other of the chemical industries—and possibly more so. The ancient glasses were usually not perfectly transparent but were translucent, in some cases nearly opaque. Transparent glass and particularly transparent glass in large sheets, is a modern production. Many of the ancient glasses and those of early modern times possessed great beauty, considered from the standpoint of the fine arts, although their utility as light transmitters is low. In Greece and Rome glass was used for plates and saucers and other table ware, for pitchers and ornamental objects, as tile in pavements and walls, but scarcely at all in windows. With the advent of transparent glass the production of the translucent varieties did not expand, until finally the art languished in many countries and has but recently been revived for many decorative purposes. It should be noted that the art was never really lost, but the interest in and demand for translucent, tinted and rough-surfaced glass was low.

The dyeing industry is another which dates from the remotest antiquity and which was developed without the aid of scientific chemistry, on an empirical groundwork. However, ancient colors, largely derived from vegetable sources, were reproducible. The use of mordants was practised by many ancient peoples, particularly by the ancient Egyptians, who used them not only for fixing colors, but for producing different shades from the same dye bath. With increasing commerce between nations, new sources of dyes became available and the vegetable-dyeing practise had reached a high degree of perfection when the coal-tar dyes were brought forth in the chemical laboratory to the wonderment of mankind and the revolutionizing of the industry. It has never been claimed, I believe, that the art of dyeing with vegetable colors has been lost or not practised. But there is a strong tendency at the present time to disparage the aniline colors. It is very commonly said and accepted as true that vegetable dyes are superior to coal-tar dyes. That vegetable dyes are fast and coal-tar dyes are not. Persia has recently prohibited the exportation of rugs and fabrics dyed with anything but vegetable dyes, ostensibly to maintain her reputation in the rug industry. Who shall come forward and refute these charges, which are of course all but groundless? There are good and bad dyes, both coal tar and vegetable, and the best dyes must be skilfully used to produce good results. Let us hope that the coal-tar dyes will be increasingly appreciated, and that the time will not come when people will lament the lost art of vegetable dyeing!

But what about the cement and plaster of the ancients which outlasted the ages and even the stones which it held together? In the first place any cement or plaster which was not remarkably durable could not possibly have been preserved to this day. The ancients in various countries and at various times have been well acquainted with lime, burned clay-limestone (hydraulic lime), hydraulic cement, vari-

ous natural cements, puzzolan, and plaster. Would it not be strange if among the materials used some would not be found to yield a cement of unusual strength? And if the setting process continued through the ages and conditions were such that weathering did not seriously attack it, the final product yielded would certainly be extremely hard. But in any case it is certain that the weaker cements have not come down to us but have been disintegrated long ago. The cement which is being made in enormous quantity to-day under scientific control will probably outlast any similar material which the world has seen.

But we may go a step farther in our inquiry after relegating the "lost arts" to the same mythological museum which holds the lost Atlantis. Not only is it unlikely that there are any "lost" chemical arts, but it is highly probable that ancient peoples were ignorant of many arts attributed to them, and which are well known at the present day. Such a misunderstanding could probably best be dispelled by a carefully compiled history of arts and manufactures, particularly ancient arts and manufactures. The production of such a book is a consummation devoutly to be wished.

I have an idea that it is not a difficult matter to gain a mental picture of conditions in ancient workshops. I believe that the mental attitude of artisans has not changed much during the lapse of hundreds or even thousands of years. Go into any small shop at the present day where a specialized art or craft is practised and I fancy that you will find the workers there in all essential respects, so far as their craft is concerned, like the craftsmen of distant ages. You will find there the same lack of organized knowledge, the same sort of unnecessarily detailed and elaborated empirical knowledge, the same narrow conservatism and adherence to formulæ and rule-of-thumb methods. If you talk to the men you may learn how they learned their craft; of the most skilful members of the craft they have known; if you gain their confidence they may tell you of their past experiments (most of them foredoomed to failure) and of future experiments planned, when time permits or when they obtain material possessed of certain hypothetical properties. And you will be impressed by the way results are sometimes accomplished in spite of the use of the clumsiest mental and physical methods of experiment imaginable. A typical craftsman will experiment with all the materials he can lay hands on without the slightest scientific consideration of the case, in an effort to produce a certain result. These things are interesting and we must hope they will never be altogether lost. But our ideal for the present and the future must be a large and adequately organized industry, resting firmly on engineering skill and chemical investigation, operating with a full understanding of all its processes and with assurances of consistent and logical future development and expansion.

W. D. Richardson

THE ELIZABETH THOMPSON SCIENCE FUND

The thirty-sixth meeting of the board of trustees was held in Boston, Mass., on February 10, 1911.

The following officers were elected:

President—Edward C. Pickering.
Treasurer—Charles S. Rackemann.
Secretary—Charles S. Minot.

Reports were received from the following holders of grants, and were accepted as reports of progress: Grant 98, J. Weinzirl; 109, A. Nicolas; 111, R. Hürthle; 119, J. P. McMurrich; 121, A. Debierne; 123, E. C. Jeffrey; 131, F. W. Thyng; 133, J. F. Shepard; 137, C.

H. Eigenmann; 140, K. E. Guthe; 144, G. A. Hulett; 146, M. Nussbaum; 149, P. A. Guye; 150, C. A. Kofoid; 152, W. D. Hoyt; 154, J. P. Munson; 155, H. P. Hollnagel; 156, R. Thaxter; 157, L. Mercier; 158, H. V. Neal.

The secretary stated that during the past year no reports had been received from grants 22 and 27, awarded in 1889; 117 (1905); 124 (1905); 142 (1908), and 147 (1909). Grants 107 and 134 were withdrawn, since the recipients were unable to carry on the work for which the grants were awarded, and had repaid the total amount of the grant. It was voted to close the records of the following grants, since the work had been satisfactorily completed, and the results published: 138, Mme. P. Šafařík; 141, J. T. Patterson; 148, C. C. Nutting; 159, B. M. Davis; 160, L. J. Henderson, and to close upon receipt of publications the following: 136, H. Z. Kipp; 161, O. von Fürth. The secretary reported that additional publications had been received from W. Doberck (Grant 153), and from J. Koenigsberger (Grant 139), making a total of six publications aided by this grant.

An unusually large number of applications was received, and the trustees regretted that they were obliged to decline several which were highly deserving of aid.

It was voted to make the following new grants:

162. $200 to Superintendent O. H. Tittmann, Coast and Geodetic Survey, Washington, D. C., for observing variations of latitude by means of a photographic zenith tube.

163. $200 to Professor R. L. Moodie, University of Kansas, for phylogenetic studies of Amphibia.

164. $200 to Professor J. M. Aldrich, University of Idaho, for a study of invertebrates, especially insects, found in and about the western salt and alkaline lakes.

165. $150 to Professor M. E. Haggerty, Indiana University, for the study of instinctive reactions in newly born dogs of various breeds, and of the inheritance of these reactions.

166. $200 to Professors F. C. Blake and C. Sheard, Ohio State University, for verification of the Kirchhoff-Abraham generalization of the Thomson formula for the discharge of a condenser.

167. $150 to Dr. E. Rohde, Heidelberg, Germany, for studies of the metabolism of the mammalian heart.

168. $125 to Dr. H. Freundlich, Leipzig, Germany, for a study of the kinetics of the transformation of aliphatic to aromatic compounds.

169. $150 to Professor G. A. Hulett, Princeton University, for further studies of the electrochemical equivalent (in continuation of Grant 144).

It was voted that grants shall not be made for the purchase of books or ordinary laboratory apparatus, or for living expenses, or for appointments essentially similar to scholarships or fellowships. It was voted to request, but not to require, that all applications shall be type-written.

CHARLES S. MINOT,
Secretary

HARVARD EXCHANGE OF TEACHERS WITH COLLEGES IN THE MIDDLE WEST

HARVARD UNIVERSITY has arranged an annual exchange of teachers with four of the colleges in the middle west—Colorado College, of Colorado Springs, Colo.; Grinnell College, formerly Iowa College, of Grinnell, Ia.; Knox College, of Galesburg, Ill., and Beloit College, of Beloit, Wis. Every year, until the arrangement is terminated, Harvard University is to send a professor who will spend an equal portion of half an academic year with each of the four colleges mentioned above, and during that time will give to the students of these institutions such regular instruction in their courses as may be arranged by their faculties. The salary of this professor will be paid by Harvard University. His traveling expenses will be borne by the four colleges already referred to, and each of them will provide his maintenance while he is in residence. The professor will be selected every year by Harvard University, with the approval of the cooperating colleges, and he will go in the first or second half-year, as may be agreed. In return, each of the four colleges is expected to send to Harvard University each year one of its younger instructors for half a year, and during that time he will be appointed an assistant in some Harvard course; he will teach

and will be paid as though he were a regular member of the Harvard University staff. Unless by special agreement, he will not be required to give more than one third of his time to teaching, and may devote the rest of it to graduate and research work in any of the departments of the university. Each college is to notify Harvard University of the appointment as early as possible in the preceding year. The arrangement will go into effect in the academic year 1911–12. The first professor of Harvard University to take part in this exchange will be Albert Bushnell Hart, Ph.D., LL.D., Litt.D., Eaton professor of the science of government. His term of service will fall in the second half-year.

SCIENTIFIC NOTES AND NEWS

Mr. Samuel Franklin Emmons, eminent for his contributions to the scientific study of ore deposits, died of asthma on the morning of March 28, at his home in Washington, D. C., aged seventy years. On the afternoon of March 30, the members of the United States Geological Survey united in a short memorial service in appreciation of his character and work.

Dr. Theobald Smith, professor of comparative pathology in Harvard University, has been appointed visiting professor at the University of Berlin, for the second half of the academic year 1911–12.

Professor Edward L. Mark, director of the Harvard Zoological Laboratory, has been elected a foreign member of the Königlichen Böhmische Gesellschaft der Wissenschaften in Prague.

Dr. Lazarus Fletcher, F.R.S., director of the British Museum (Natural History), has been elected an honorary fellow of University College, Oxford.

Dr. C. G. Abbot, director of the Astrophysical Observatory of the Smithsonian Institution, will this summer conduct an expedition to southern Mexico to make measurements of the sun's radiation, which will be compared with simultaneous observations on Mt. Wilson. The congress has made a special appropriation of $5,000 for this work.

Professor Hiram Bingham, of Yale University, will on June 10 leave for a six-months' expedition to Peru. He will be accompanied by a geologist, a topographer and a naturalist and it is hoped by a pathologist. He expects to explore the seventy-third meridian from the Amazon Valley to the ocean.

Dr. Roland B. Dixon, of Harvard University, is spending the second half of the academic year in the Bureau of the Census in Washington, devoting himself to a statistical inquiry in regard to the Indians.

Mr. William S. Kienholz has been appointed director of a marine biological laboratory located at San Pedro, Cal. This laboratory is in connection with the Los Angeles schools and the city of Los Angeles expects to spend ten thousand dollars for the laboratory during the next two years.

Dr. Marie C. Stopes, lecturer on paleobotany in the University of Manchester, and Dr. R. R. Gates, of the Missouri Botanical Garden, who met at the Minneapolis meeting of the American Association for the Advancement of Science, were married at Montreal on March 18.

The April meeting of the American Mathematical Society will be held at University of Chicago on Friday and Saturday, April 28–29. At this meeting Professor Maxime Bôcher will deliver his presidential address, the provisional title of which is: "Charles Sturm's Published and Unpublished Work on Differential and Algebraic Equations." Except for the summer meetings, this will be the first united meeting of the whole society since 1896.

Dr. S. Weir Mitchell delivered the last lecture of the season before the Harvey Society on Saturday evening, April 1, at the New York Academy of Medicine. The subject of the lecture was "William Harvey, the Discoverer of the Circulation of the Blood."

Professor A. A. Noyes, director of the Physico-chemical Research Laboratories at the Massachusetts Institute of Technology, recently made an address before the College of Science of the University of Illinois, in

which he outlined the research work in progress at the Massachusetts Institute as well as the general policy of the department.

PROFESSOR SVANTE ARRHENIUS, of Stockholm, delivered a lecture before the Scientific Association of the Johns Hopkins University on the evening of March 24 on "The Laws of Adsorption." In this lecture Arrhenius gave an account of some of his recent work in this field.

DR. VICTOR GOLDSCHMIDT, professor of crystallography at the University of Heidelberg, has visited the University of Michigan and has given several lectures before classes in mineralogy and geology.

PROFESSOR W. H. FREEDMAN, of Pratt Institute, Brooklyn, lectured at the University of Vermont on March 27 on "Some Recent Engineering Achievements," and on March 29 on "Wireless Telegraphy."

DR. HENRY P. BOWDITCH'S books and scientific apparatus and the sum of $4,000 are bequeathed to Harvard College for the Medical School by the provisions of his will. The bequest of $4,000 is "to be added to the fund left by my father, J. Ingersoll Bowditch, the income of which shall be expended under the direction of the professor of physiology for the purpose of original investigation."

A BRONZE tablet in honor of Albert Benjamin Prescott, formerly director of the Chemical Laboratory of the University of Michigan, was put in place at the entry of the new chemical building at the university on March 15.

MRS. ELLEN HENRIETTA SWALLOW RICHARDS, instructor in sanitary engineering in the Massachusetts Institute of Technology, well known for her valuable contributions to sanitary problems, has died at the age of sixty-nine years. Mrs. Richards was the wife of Dr. Robert H. Richards, professor of mining engineering at the institute.

EDWARD FITCH CUSHING, Ph.B. (Cornell, '83), M.D. (Harvard, '88), one of the foremost physicians and public men of the city of Cleveland, died on March 23, at the age of forty-nine years. He had practised medicine in Cleveland for the last eighteen years and was professor of the diseases of children in Western Reserve University. Dr. Cushing was the fourth of his family to follow the medical profession. His great-grandfather was a physician in New England; his grandfather, Erastus Cushing, and his father, Henry Kirke Cushing, were both physicians in Cleveland. His brothers are William E. Cushing, a lawyer and trustee of Western Reserve University; Henry P. Cushing, professor of geology in Western Reserve University, and Harvey Cushing, professor of surgery in the Johns Hopkins University.

AT a special meeting lately held in the Berlin Royal Museum of Natural History, as we learn from *Nature*, the committee for the exploration of the dinosaur-bearing deposits of German East Africa exhibited a few of the more remarkable specimens already received. The collection consists chiefly of the remains of Sauropoda, some much larger than the gigantic species of North America. One humerus measures more than two meters in length, and some of the cervical vertebræ are twice as large as those of Diplodocus. The leader of the exploring party, Dr. W. Janensch, reports the discovery of two new localities in which dinosaurian bones are abundant.

THE Paris Academy of Medicine, which, in deference to the representations of the British government, recently agreed to designate the disease known as Maltese fever by the term "Mediterranean fever," has decided to adopt as its scientific appellation the name *Melitococcie*.

MRS. JOHN H. CASWELL, of New York, has presented to Trinity College the valuable collection of minerals gathered during his lifetime by the late John Henry Caswell. Mr. Caswell was graduated from Columbia University in 1865, and after three years' study in Germany became assistant in mineralogy in the newly organized Columbia School of Mines. In 1877 his business interests compelled him to give up the career of a scientific man, but he maintained his interest in mineralogy, and his collection became valuable. It contains about 4,000 specimens scientifically arranged and illustrates very completely the

typical crystal forms and their variations for a large range of mineral species.

That 126 persons bitten by rabid animals in Wisconsin have been treated during the past fourteen months at the Pasteur Institute established in connection with the hygienic laboratory at the University of Wisconsin, is shown by the report of Dr. M. P. Ravenel, the director. Over 170 animals supposed to have suffered from hydrophobia were examined by the experts at the laboratory, and the spread of the disease has been checked to a great extent. The patients treated came from 61 cities and towns in the state. Six persons are under treatment at the present time at the laboratory. The entire Pasteur treatment is given the patients at a cost of $25, about one fourth the cost at institutions not conducted by the state. Funds are being asked the present legislature sufficient to allow the laboratory to administer the treatment free of charge.

The production of natural gas in the United States in 1909, as ascertained by a joint canvass made by the United States Geological Survey and the Bureau of the Census, is estimated by B. Hill, in charge of this work, under the supervision of D. T. Day, to have been $55,000,000, an increase of only about $359,626 over that of 1908. There were no great changes in the industry during the year, the production continuing to decline in Kansas, and an increase being made in Oklahoma and in the Caddo field in Louisiana and in Texas. An interesting feature was the supplying of Fort Worth and Dallas from the gas fields of Clay County, Texas. For the year 1910 the total production is estimated at $57,000,000, an increase of about $2,000,000 over 1909. During 1910 a feature of great interest was the development of what promises to be a very large supply of natural gas in the Buena Vista Hills, Kern County, Cal., east of the Sunset-McKittrick oil field. Arrangements were made and practically completed during the year for piping this gas to Bakersfield and other towns in San Joaquin Valley.

An International Congress of the Applications of Electricity is to be held in Turin, Italy, on September 9–20. *Nature* states that this congress, as its title implies, will deal with questions of practical import, so that electrical engineers will be able to participate largely in the discussions. The chief endeavor of the organizing committee, which is under the chairmanship of Professor Luigi Lombardi, has been so to draw up the program that the congress may be international in character as well as in name. To attain this object, the cooperation of the International Electrotechnical Commission, with its local committees now established in many countries, has been obtained, as well as the assistance of the societies and associations in all countries dealing with electrical matters. With the help of these organizations, official reporters have been selected, and already many assurances have been received that numerous papers will be presented to the congress from all parts of the world. The initiators of the congress are the Italian Electrotechnical Society and the Italian local committee of the commission mentioned above. The congress is under the patronage of the Duke of the Abruzzi, who is the president of the committee of honor, upon which Professor Elihu Thomson and Colonel Crompton, the president and honorary secretary respectively of the commission, have been elected members. Papers may be presented in French, English, German and Italian, and the discussions will be carried on in all these languages.

The annual meeting of the British Medical Association will be held in Birmingham from July 25 to July 28. The president this year is Dr. H. T. Butlin, consulting surgeon to St. Bartholomew's Hospital, and the president-elect Professor Robert Saundby, professor of medicine in the University of Birmingham. The president will deliver his address on Tuesday, July 25; the address in medicine will be given on July 26 by Dr. Byron Bramwell, president of the Royal College of Physicians of Edinburgh, and the address in surgery on July 27 by Professor Jordan Lloyd, of Queen's Hospital, Birmingham. For the purposes of the scientific business of the meeting sixteen sections have been authorized by the council.

The subjects to be dealt with and the presidents in each section are indicated below:

Anatomy and Physiology.—Professor T. H. Bryce, Glasgow.

Dermatology.—Dr. James Galloway, London.

Diseases of Children.—Dr. Otto Kauffmann, Birmingham.

Electro-therapeutics and Radiology.—Dr. Hugh Walsham, London.

Laryngology, Otology and Rhinology.—Mr. Frank Marsh, F.R.C.S., Birmingham.

Medical Sociology (including medical inspection of school children, hospital administration, and contract practise).—Dr. George Reid Stafford.

Medicine.—Dr. Alfred Carter, Birmingham.

Neurology and Psychological Medicine.—Dr. Edwin Goodall, Whitchurch, Cardiff.

Obstetrics and Gynecology.—Professor Edward Malins, Birmingham.

Odontology.—Professor Frank Huxley, Birmingham.

Ophthalmology.—Mr. Henry Eales, M.R.C.S., Birmingham.

Pathology.—Professor R. F. C. Leith, Birmingham.

State Medicine and Industrial Diseases.—Professor A. B. Hill, Birmingham.

Surgery.—Sir T. F. Chavasse, Birmingham.

Therapeutics, including Dietetics.—Sir Robert Simon, Birmingham.

Tropical Medicine.—Sir Francis Lovell, London.

THE department of forestry at the University of Montana proposes to organize a summer cruise for students of forestry. The party will probably start from Missoula, about July 1, for a tour of the western forest regions, visiting the best stands of timber, viewing the operations of the Forest Service on the national forests, such as timber-sales, planting, reconnaisance, etc.; also the operations of private concerns in logging and milling. Lectures on different phases of forestry will be given at appropriate points. The regions visited will include the northern Rocky Mountains, Puget Sound, the sugar pine country of southern Oregon and the redwood belts of California. A feature of the work will be the opportunity afforded for acquiring experience in camping, riding and packing, and familiarity with western conditions. The course will continue for about six weeks, and will be open to a limited number. Those interested should address Professor J. E. Kirkwood, University of Montana, Missoula. The winter school for forest rangers at the University of Montana has just concluded its second session. An extension of the course is contemplated covering two years during the winter seasons. Courses are given in various phases of forestry as related to the administration of national forests. The staff of instruction includes part of the university faculty and officers of the Forest Service.

WE learn from *Nature* that a plan for the establishment of an Institute of Technical Optics has been approved by the education committee of the London County Council, and will shortly come before the council. The object of this scheme is the establishment in London of an Institute of Technical Optics for the training of opticians and optical instrument makers, and it is also hoped that valuable work may be done in connection with investigations in optical glass. The education committee proposes that the council shall grant £35,000 for the building and equipment of the new institute, the site, valued at about £12,000, having been already provided by the Northampton Polytechnic Institute, under the direction of the governors of which the new institute will be maintained. To ensure that the work shall be on the best lines, it is proposed to appoint a consultative committee representative of the trade, scientific and other organizations interested. The new institute will be maintained from funds at present used to maintain the technical optics department of the Northampton Polytechnic Institute, additional grants from the Board of Education and additional contributions from the London County Council. Later it is hoped that, in view of the national character of some of the work which may be developed, assistance may also be obtained from imperial funds. In the proposals under consideration, provision is made for the teaching of optical science with its technical applications, and of other subjects of value to the manufacturer and designer of optical instruments, and to the optician.

A new list of publications of the United States Geological Survey, just issued, contains the titles of more than a thousand books and pamphlets. These reports cover a wide range of subjects. They include not only papers on geology and topography but reports on water resources and on technology. The Geological Survey was the nursery of the United States Reclamation Service and the Bureau of Mines, which now, in full growth, are carrying along successfully work begun by the survey years ago. The survey, however, still continues its work on water resources and includes discussions of technology in its annual volume "Mineral Resources of the United States." A glance at this list will show the great diversity of the subjects considered and the manifold nature of the science of geology. The reports include discussions of geologic chemistry, mineralogy, petrography and paleontology, as well as ore deposition and other matters of very practical importance. Much of the survey's late work has been directed to the study of mineral deposits of economic value. The work done in land classification has not yet found detailed expression in the survey's reports, but some papers prepared as a result of land-classification surveys have been printed annually in bulletins entitled "Contributions to Economic Geology." The list may be obtained by applying to the director of the survey at Washington, D. C.

The statistics of production of gems and precious stones in the United States in 1909, which were collected by the Geological Survey and the Bureau of the Census and have just been published, show a large increase in value over 1908. The total value in 1909 was $534,380; the value in 1908 was $416,063. The increase is due chiefly to larger outputs of turquoise, tourmaline, variscite, chrysoprase, californite and kunzite. The production of a number of precious stones—as beryl, garnet, peridot and topaz—showed a decrease in value. The output of turquoise matrix and turquoise amounted to over 17 tons, that of variscite to over 3½ tons and that of tourmaline to over 2½ tons. An account of the occurrence and production of gem materials in the United States, with notes on the precious stones industry, has just been published in pamphlet form by the Geological Survey in an advance chapter from "Mineral Resources of the United States, Calendar Year 1909." The pamphlet, entitled "The Production of Gems and Precious Stones in 1909," was prepared by Douglas B. Sterrett and may be obtained free by applying to the director of the survey.

UNIVERSITY AND EDUCATIONAL NEWS

The legislature of Missouri has recently made appropriations for the state university which include $100,000 for a new laboratory of physics and $60,000 for a laboratory of agricultural chemistry. A building for veterinary science is now in course of construction at a cost of over $30,000. In the recent appropriations the amount appropriated for salaries and current expenses exceeded that of two years ago for similar purposes by $152,000. This amount will be mainly devoted to the increasing of salaries and the enlargement of the faculty.

An anonymous donor has given Oberlin College the property fronting on South Professor Street in Oberlin, known as the Johnson estate. This comprises approximately twenty-two acres, and is valued at from $35,000 to $40,000.

By the will of Mrs. Amelia Worthington, of Boston, widow of Bishop Worthington, of Nebraska, a bequest is made to Williams College amounting to $30,000, dependent upon certain contingencies.

Messrs. Mallinckrodt, of St. Louis, Mo., announce that they will pay a prize of $500 to a chosen student of chemistry in the Graduate Schools of Harvard University during the academic year 1911–12, on condition that he will serve in the Mallinckrodt Chemical Works in 1912–13 at a suitable salary.

Trinity College has given Cambridge University the sum of £1,000, which is to be used toward the erection of buildings for physiology and for experimental psychology.

The University of Manchester has received an anonymous gift of £1,000 for promoting research work in medical subjects.

BY vote of the board of trustees it was decided last year that at the close of the school year 1911 the academy of the University of Illinois, which has existed since 1876, should be discontinued. Mr. J. P. Gilbert, who was an instructor in zoology, has just been elected head of the department of biology and agriculture in the Southern Illinois Normal at Carbondale. Another member of the academy force, Mr. S. E. Boomer, goes also to the Southern Illinois Normal as head of the mathematics department.

DR. HANS ZINSSER has been promoted to be professor of bacteriology in Stanford University.

THE School of Engineering of the University of Pittsburgh announces a new course in mechanical railway engineering which will be under the direction of Mr. D. F. Crawford, general superintendent of motive power, Pennsylvania lines west of Pittsburgh. Students working in this course will combine their theoretical course with practical work in connection with the Pennsylvania lines west of Pittsburgh.

THE Bryn Mawr European fellowship has been awarded this year to Miss Helen Tredway, who specialized in physics and chemistry; the president's European fellowship to Miss Mary E. Pinney in biology, and the Mary E. Garret European fellowship to Miss Margaret E. Brusstar, in mathematics.

DISCUSSION AND CORRESPONDENCE

THE ACOUSTICAL ENGINEER

THE subject of acoustics as applied to auditoriums deserves a much greater interest on the part of physicists and architects. It is not just, however, to offer criticism without considering some of the reasons for this lack of attention. The physicist realizes that there are many practical problems which constantly tempt him to turn from the performance of his proper function. Moreover he knows that physicists (Sabine and others) have already obtained results far in advance of what are actually utilized by architects to-day. On the other hand, the architect is a man of many troubles and is therefore not inclined to add to his cares by indulgence in experimental work or by applying Sabine's formula to a proposed auditorium. His fee does not cover such expert work and he very naturally attempts to do well that for which he is paid. In short, there is not a sufficient incentive for active interest on the part of either the physicist or the architect.

In spite of the excellent work that has been done, particularly by Sabine, our knowledge of the subject of architectural acoustics is quite limited. It is true (although doubted even by some physicists) that one can not only correct excessive reverberation of an auditorium already constructed, but he can even compute what effect will be had in a proposed structure. This, however, is only a small part of the achievement that will some day be possible. Again, our methods of correcting excessive reverberation are not entirely satisfactory either to an architect, or to a layman who desires the remedy to be both permanent and sanitary. It is not for the physicist to improve our present methods of remedying excessive reverberation for this is a practical problem involving structural knowledge. Neither can he be expected to think of the problems of theoretical interest which will sooner or later confront one engaged in applied acoustics.

It seems, then, that the future progress of the subject of acoustics as applied to auditoriums rests in a very large measure upon the activity of what might be termed the "acoustical engineer." This engineer must be an architect of scientific training—one who will be interested alike in the architectural and scientific aspects of the problems. Generally speaking, each auditorium needs a slightly different study and one who is to succeed must have sufficient scientific interest and ability to make the necessary investigations. As so well known, absorbing material applied to the proper area of surface will correct for excessive reverberation. But the amount of area that can be utilized, the character of the interior finish, etc., enter into the

problem. The absorbing material applied should be tested experimentally so that the area covered will give a satisfactory result. Moreover, in cases of well-defined echoes each auditorium will probably require more detailed study.

There are an increasing number of architects in this country who are actively interested in the subject of architectural acoustics, but, with one exception, they have not devoted much time to experimental investigation. This exception is an architect who is devoting his entire time to acoustical engineering. On the other hand, the public does not realize the present knowledge on the subject of architectural acoustics and the architect does not make a serious attempt to educate. The purpose of this note is to call the attention of scientific men to the acoustical engineer and to urge their active interest so far as the education of the public and the recognition of the need of such a consulting engineer are concerned.

G. W. Stewart
The State University of Iowa

Academic Efficiency

To the Editor of Science: Since on several occasions there have appeared in Science certain criticisms of the Cooke report of the Carnegie Foundation, I hope that you may be willing to publish a brief statement of an opposite view.

Both the report itself and its introduction by Dr. Pritchett state clearly that the opinions of an "outsider" were considered desirable. The recent criticisms of collegiate conditions by many who have not actually studied at first hand the things they condemn seem to have led to the investigation upon which the report is based.

Most of the opinions set forth in the report are precisely those which any well-informed person not connected with a college would hold after a similar study of what actually exists. Moreover, not a few persons on the inside of the college world hold quite similar views. In some ways certain of us go even farther in condemning a part of the things that are more or less characteristic of the college life of to-day.

Especially in trying to fit young men to meet successfully the practical conditions of the real business world, we lament most deeply the woeful lack of the "snap and vigor" which Mr. Cooke found wanting in most of the institutions visited. The "lack of intensiveness" appeals to us much more as a hindrance to the proper preparation of our students for what we know will be required of them in the near future than for any other reason. Not a few of those who employ many highly trained workers positively condemn the college graduate, and will not hire him until he has been whipped into line by sufficient practical experience after his graduation. Some of us know that this is not on account of the subjects which we teach or do not teach in our courses, but rather on account of the general attitude of many of our graduates toward the work that may be assigned them. During the first half year of the cooperative system at the University of Cincinnati, Dean Schneider says he was frequently called to his telephone to listen to something similar to this: "That cub you sent down here thinks this is a university. He won't work." Far too many young men in the colleges and in the collegiate departments of the universities "won't work." Too many students in all of our institutions have no proper conception of the real economic value of their own time or of the opportunities within their grasp. Such ones do not make efficient use of what is provided for them, in funds and in equipments of various kinds. They cut class and laboratory exercises without adequate reasons. They try all kinds of schemes to get out of regular and systematic work. They neglect to do many of the things assigned to them, in many cases up to what they consider the very lower limit of a bare passing grade. Sometimes they ask if they can "cut" this or neglect that and still have a chance to "pass." They give time, energy and most of the thinking that they do, to things which can not be of the least permanent value to them in later life.

Such students do these and many other

things which in the commercial world would not be tolerated for a single day. Some colleges have a much greater proportion of this kind of students, but all colleges have far too many. It is certainly not logical to say that the work of the colleges is so admirable in some respects that the undesirable should be overlooked.

The colleges continually appeal to the public for money and for students. Then why is not this public entitled to consider all phases of college administration and college work? It is considered wise to examine all sides to other questions, and to give the proper relative weight to all things involved. Why should the college question demand a special kind of treatment? Whether instructors and students accomplish as much as they might with the facilities available and with the funds expended is not by any means unimportant. Unless we can claim exemption from any form of criticism, we have no grounds for objection to criticism here.

However true it may be that other things connected with the work of the colleges are more important than those discussed in the Cooke report, no convincing reasons have been given, nor can be given, to show that the bad in our college system can not be improved without the least detriment to the good. In fact to improve in one line must naturally tend to improve others also. To waste time and money will not help any student to become a great scientist or a good citizen. A long, tedious and expensive investigation is more likely to bear fruit in the hands of one who has some idea of the value of his own time and the other things he employs. The dilettante in science hinders its progress more than he helps.

I can not see how improvement in the business management of our colleges or improvement in the quality of our student body by sending home those who will not do a reasonable amount of work, or improvement in other lines that might be mentioned, can in the least do other than "tend to assist those conducting these institutions and their students towards the attainment of their own highest ideals in scholarship, character development and culture."

B. B. BRACKETT
BROOKINGS, S. D.,
February 21, 1911

LABORATORY TABLE TOPS

TO THE EDITOR OF SCIENCE: In SCIENCE for February 17, 1911, I notice a short discussion of suitable material for laboratory table tops. Having just found something quite satisfactory, which, so far as I know, is new, the mention of it may be of interest.

The table I have recently tried has a hexagonal top approximately six feet in diameter. The substratum is of pine seven eighths thick and of pieces cross-joined. This substratum is overlaid with a three eighths cover of "asbestolith," a composition of asbestos and cement. This cover of asbestolith was infiltrated with paraffin. To hold the cover the substratum was partially bored to supply small holes which were filled with the asbestolith. This asbestolith is laid on like cement and hardens. It can be made to cover the edge of the top so that the top has the appearance of a solid slab. This top has an absolutely continuous surface, a high degree of resilience, is acid and alkali proof, and can be repaired at any time to original form. The only effect of heat is to melt the paraffin, but this has not proved a serious objection, as it can always be rubbed down to look well. The work was done for me by the Waco Cement Company, but no doubt can be duplicated almost anywhere.

RAYMOND H. POND
EXPERIMENT STATION,
COLLEGE STATION, TEXAS

TOTEMISM

IN SCIENCE for February 17 there appeared a report of a paper on "The Totemic Complex" read by myself at a meeting of the Anthropological Society of Washington, on January 17, 1911. I wish to correct some statements made in that report, which might prove misleading. The beginning of the study of totemism does not date back to the sixteenth but to the later half of the nineteenth century. The various features of totemism (exogamy,

tabu, animal descent, etc.), although "they exist separately and independently from one another," are also found associated in totemic complexes. If they were "nowhere found united" and were "not correlated to one another," there would be no totemic problem.

A. A. Goldenweiser

February 23, 1911

Evidence of the Zebra in the Pleistocene Fauna of France

From certain drawings by paleolithic artists, reproduced by Édouard Piette in his work on "The Art Relating to the Reindeer Age,"[1] it would appear that a species of zebra had wandered northward, with other members of the African fauna, during the Pleistocene, at least as far as central France. On plate XXX. of Piette's work are reproduced two engraved figures of an animal that seem undoubtedly intended to represent a zebra. In one of these (Fig. 6) only the head and neck appear, while in the other (Fig. 7) almost the entire animal is drawn. The reference to these figures in the accompanying text is as follows:

Fig. 6. Engraving representing the head and neck of a horse-like animal with erect mane, delicately striped like the zebra. The stripes are formed by rows of points almost contiguous. One notices in the front of the head a series of marks like chevrons and under the neck, two short parallel stripes. Grotte des Espélungues, A'Arudy.

Fig. 7. Engraving representing an animal like a horse, delicately striped like a zebra, with erect mane, small head having small ears. The stripes are indicated by series of parallel lines or of points. The tail is incompletely drawn. Grotte de Tayngen.

The striping of the hind quarters in Fig. 7, suggests the "gridiron" pattern on the rump of the rock or berg zebra (*Equus zebra*), an existing species, now on the verge of extinction, but formerly abundant in the mountainous districts of Cape Colony. Here, however, the likeness ends, for the absence in the engraving of stripe marks on the limbs, the presence of which, clear down to the hoofs, is a character of the above species, would suggest Burchell's zebra (*Equus Burchelli*) as would also the small size of the ears.

A careful study of these drawings forces one to the conclusion, it seems to me, that a species of zebra was present in western Europe when paleolithic men were engraving the lineaments of reindeer, bison, horse, mammoth, cave bear, woolly rhinoceros and other animals of that strange and interesting time. Surely this ancient artist did not stretch his imagination to so accurately delineate the stripe pattern of a zebra, without having seen it. All of these paleolithic engravings depict an animal most faithfully, even, at times, to minute details. The familiar sight of some beast begat an impulse that found its expression in virile representations of form, remarkably accurate considering the rude and primitive implements for engraving, that were in the hands of these artists of the remote past.

I am not aware of any previous reference to the zebra's former existence in Europe, and I present the above facts simply as evidence coming from the hand of one who without doubt knew and drew some form of zebra that later, like so many other great mammals, vanished from the northern lands.

Spencer Trotter

Swarthmore College, Pa.,
February 14, 1911

[1] "L'Art Pendant L'Age Du Renne," Paris, 1907.

Scientific Books

Termitenleben auf Ceylon; Neue Studien zur Soziologie der Tiere, zugleich ein Kapitel Kolonialer Forstentomologie. Von Karl Escherich. Jena, Gustav Fischer. 1911. Pp. xvii + 262. 68 text-figures; 3 pls.

This important contribution to our rapidly increasing knowledge of the termites, or "white ants," had its origin in a journey made by Professor Escherich during 1910 to Ceylon, and contains a very interesting account of the behavior of several of the species of that island. Four fungus-growing species (*Termes obscuriceps, redemanni* and *ceylonicus* and *Microtermes globicola*) are considered at length in the opening chapter of the work, their architecture and fungus-gardens being

described in detail and with a number of striking illustrations. The fungus (*Volvaria eurhiza*) which is cultivated and eaten by *T. redemanni* is described and figured in accordance with Petch's investigations published in 1906 in the *Annals* of the Royal Botanical Gardens of Peradenyia.

One of the most interesting portions of this chapter deals with social symbiosis, or the tendency of two species of termites or of termites and ants to inhabit the same nest. Thus Escherich often found *Termes ceylonicus* and *obscuriceps* in the same termitarium, but each species inhabited galleries of its own, and although these were mingled they did not inosculate and the two species, when the nests were undisturbed, were always separated from one another by masonry walls. If the insects of the two colonies, however, were made to meet through a breaking down of the walls, their behavior towards each other was decidedly hostile and bitter conflicts ensued.

Singularly enough, each of these species had its own fungus-gardens, the chambers containing which were seen to be intermingled when the termitarium was sectioned. Escherich believes that *T. obscuriceps* is the original architect of the nest, whereas *T. ceylonicus* is merely a "Raumparasit." Another case of similar symbiosis is furnished by *Capritermes ceylonicus* and *incola,* each of which may inhabit the nest of *T. redemanni* or *obscuriceps.* In this case, also, the *Capritermes* inhabits small burrows of its own in hills built by the *Termes* and violently attacks the latter whenever it is encountered. The *Capritermes* soldier has extraordinary asymmetrical mandibles by means of which it can jump into the air or hurl its enemies away from the battlefield. Other species, which Escherich found nesting in the mounds of *T. obscuriceps,* are *Leucotermes ceylonicus, Eutermes escherichi, Eurytermes assmuthi* and *Hamitermes quadriceps.* In all cases these lived shut off from but in very close proximity to their hosts and were always inimical to the latter when the two species were brought together. *Hamitermes, Leucotermes* and *Eurytermes* may, however, live in independent nests. Speaking in myrmecological terms, the author concludes that "all the phenomena which we ascertained regarding the living together of different termites belong without exception in the category of 'compound nests,' as opposed to 'mixed colonies.'" Concerning the relations of ants and termites he says that in Ceylon there is scarcely a termitarium which does not harbor ants. The commonest species are *Camponotus rufoglaucus* and its subspecies *paria* and *C. sericeus opaciventris.* These usually inhabit the outer walls or "Mantel-region" of the nest. Escherich was quite unable to observe any such relations as Wasmann has described as existing between South American termites and *Camponotus termitarius* and has called "phylacobiosis" on the supposition that the ant stations itself at the nest-entrance and defends its termite hosts from their enemies. Another common ant in the Ceylonese termitaria is the tropicopolitan *Plagiolepis longipes,* "which lives in nearly every mound, or at least in its immediate neighborhood, flitting like a shadow over the opened portions of the nest and rushing into the galleries and chambers to seize their occupants." In agreement with Wroughton, Escherich describes the habits of a ponerine ant, *Lobopelta ocellifera,* which he calls "die Termitenräuberin par excellence." A whole army of this ant may proceed in a file to a termitarium, break into its galleries and carry away the workers and larvæ in great numbers. An interesting new genus and species of ant, *Pœdalgus escherichi* Forel was discovered nesting in the termitaria in small chambers which evidently communicated by means of very slender galleries with the galleries or chambers of the termites. From the great disparity between the size of the queen and that of the worker—the former measuring 5.5 mm., the later 1.1–1.2 mm.—it is inferred that this species must be a thief-ant like the species of *Carebara, Oligomyrmex, Aëromyrma* and *Solenopsis,* which are also known to live as thief-ants in termitaria or the nests of other ants.

Escherich discusses, in this connection, the habits of a few guests or termitophiles, espe-

cially the carabid beetle *Orthogonius acutangulus,* the swollen or "physogastric" larvæ of which feed on the termites. Wasmann had supposed that these larvæ were adopted and fed by the termites in the place of their own huge queens, but Escherich shows that there is nothing to support this view. The first chapter of the book concludes with an account of the growth of termitaria and the architectural instincts of the worker and soldier termites.

The second chapter is devoted to the habits of the species of *Eutermes,* which have peculiar nasute soldiers, and especially to a charming account of *E. monoceros,* a black termite which goes forth in long processions fully exposed to the tropical sun to browse on the lichens on tree-trunks and the roofs and walls of houses. These processions are indeed "erstaunlich," since they may be several hundred meters long and make the most unaccountable détours, "often three and four times the shortest distance to the feeding grounds." Escherich estimates the number of individuals in a colony of this species at about 200,000. It reminds one of a common European ant, *Lasius fuliginosus,* not only in its dark color and its tendency to form these long processions, but also in its nesting habits. Its termitarium is a carton structure and, like that of *L. fuliginosus,* situated in a hollow tree-trunk. Escherich finds that it also forms on the outside of the trunk an "Abtritt," or latrine near its nest, a black stalactite-like mass which grows gradually as the workers add their feces to it and eventually drops from the tree or dissolves away in the tropical rains. It is, however, constantly renewed and is guarded by a cordon of soldiers called by Escherich guards of the latrine ("Abtrittswächter"). Since the workers and soldiers of *E. monoceros* are blind, Escherich was naturally led to investigate their "homing" instincts. Bugnion, who had previously studied this same termite in the same locality, showed that its sense of smell is very acute, and Escherich finds that the workers while they move along discharge from time to time small, black fecal masses which adhere firmly to the substratum like so many fly-specks and serve as guide-posts for the workers and soldiers that follow. He concludes, therefore, that the "spoors of the black termites not only have a more intense odor than those laid down by the ants, but are much more stable and persistent." A brief account is added of the habits of some other species of *Eutermes* and especially of the "gallery" termite (*E. ceylonicus*), which, like most species of the genus, constructs a gallery or arcade under cover of which it moves from place to place.

The third chapter is full of interesting miscellaneous observations and accounts of laboratory experiments. It opens with some remarkable notes on the queen termite and contains confirmation of Holmgren's recently published theory according to which the queen termite sweats out on to the surface of her body a substance ("exudate") which is eagerly devoured by the workers and not only keeps the helpless queen supplied with attendants, but, so to speak, binds the whole colony together. Not only are the attendant workers continually licking the body of the queen, but Escherich actually saw a worker tear a strap-like piece out of its mother's hide and lap up the liquid exuding from the wound. He noticed also that the unwieldy bodies of the queens are often scarred in such a manner as to suggest that this treatment is not unusual. The exudate thus obtained by licking or even wounding the queen is often distributed to other workers by regurgitation. From these and many other observations Escherich infers "that the eager licking of the queen has its origin not only in the cleansing instinct of the workers, but quite as much in their feeding instincts, or, as Holmgren says, in their 'exudate-hunger.'" The queen termite is therefore fed and cherished by her offspring as if she were herself a termitophile, or termite guest, and for the same reasons, and since the other castes—*i. e.,* the males, workers and soldiers and their larvæ—also have exudate organs of peculiar structure, Holmgren assumes that the whole problem of caste differentiation in these insects is to be solved with the aid of the exudate theory. In

other words, "the amount of exudate determines the amount of food and the latter determines the development of one or the other caste." It is certainly noteworthy, in this connection, that the queen termite, in the egg-laying stage, is clearly afflicted with physogastry, a condition which, as Wasmann has shown, is as characteristic of the guests of termites as the possession of trichodes is characteristic of myrmecophiles.

In the same chapter Escherich gives an account of a number of experiments on the behavior of termites brought together from different colonies. He found that alien larvæ are much less hostile to one another than are strange imagines (workers or soldiers). As would be expected, the soldiers of different species differ markedly in their methods of attacking and killing their enemies: the *Termes* soldier uses its sharp mandibles as a poniard or pair of scissors, the *Capritermes* soldier as a catapult with which to toss its enemies into the air; the *Eutermes* soldier, however, pounds its enemies with its cephalic horn and simultaneously smears their bodies with a sticky secretion from its cephalic gland; the *Coptotermes* soldier reduces its enemy to impotence by throwing over it a milky secretion. When termite colonies are invaded by small enemies, the workers often do all the fighting and the soldiers slink away; but larger and more powerful enemies are attacked by the soldiers while the workers behave rather indifferently. The main function of the soldiers is to defend the nest entrances.

Escherich is of the opinion that the negative phototaxis of termites has been greatly overestimated, but while this may be true of *T. redemanni* and *obscuriceps* which were seen building, and of *E. monoceros* which was seen foraging "am hellen Tage im grellsten Sonnenschein," the other observations cited do not prove the indifference of termites in general to light. Ants, too, are in the main negatively phototactic, though they often forage and build in the bright sunlight.

The fourth chapter is devoted to the methods of exterminating termites, a matter of great importance in tropical countries where these insects are often a serious menace to all wooden structures, books, papers, cloth and even to the stems of growing plants (tea, cacao, etc.). The following measures are recommended: first, stopping some of the main openings of the nest with tow or "waste" soaked with carbon bisulphide and closing all the remaining openings with clay or earth; second (and this is recommended as the most effective treatment), the use of the "universal ant-exterminator," an appliance manufactured by C. Henwood & Son, of Durban. This consists of a small charcoal stove connected on one side with a hand-pump (resembling that used for inflating bicycle tires) and on the other with a rubber hose provided with a nozzle. On glowing charcoal in the bottom of the stove a small quantity of a powder consisting of 85 parts of arsenic and 15 parts of sulphur is placed, the nozzle of the hose is inserted in the entrance of the termitarium and the poisonous fumes which fill the stove are forced into its galleries and chambers by working the pump. The hose is then removed, the openings are at once plugged with clay and the nest is left undisturbed for several days. If at the end of a week's time some of the termites are found to have survived, the fumigation has to be repeated. Escherich describes an interesting apparatus for locating termites, a "Termitensucher" manufactured by Friedrich Suck, of Hamburg, for use in the German colonies. This consists of a microphone inserted in a funnel at the end of a steel tube and connected with a telephone receiver. When the tube is stuck into the earth the noise made by the crawling termites can be distinctly heard through the receiver even when they are working at a considerable depth in the soil. By means of this apparatus termites may be readily located in the tree-trunks of orchards or estates or in the walls of houses and marked for treatment with the arsenic-sulphur fumes.

The work closes with the following series of valuable appendices by various authors on the material collected by Professor Escherich in Ceylon; a taxonomic account of the Ceylonese

termites by Holmgren; a similar account of the ants by Forel; descriptions of the termitophilous coleoptera by Wasmann; a description of a new cricket (*Myrmecophila escherichi*) which has become termitophilous, by Schimmer; termitophilous thysanura, myriopoda and coleopterous larvæ by Silvestri; a termitophilous earthworm (*Notoscolex termiticola*) by Michaelsen.

W. M. Wheeler

SCIENTIFIC JOURNALS AND ARTICLES

The contents of *The American Journal of Science* for April are as follows:

"Ionization of Different Gases by the Alpha Particles from Polonium and the Relative Amounts of Energy Required to Produce an Ion," T. S. Taylor.

"Heat Generated by Radio-active Substances," W. Duane.

"Contributions to the Geology of New Hampshire. IV. Geology of Tripyramid Mountain," L. V. Pirsson and Wm. North Rice.

"Note on a Method in Teaching Optical Mineralogy," F. W. McNair.

"New Paleozoic Insects from the Vicinity of Mazon Creek, Illinois," A. Handlirsch.

"Results of a Preliminary Study of the so-called Kenai Flora of Alaska," A. Hollick.

SPECIAL ARTICLES

THE ORIGIN OF FIVE MUTATIONS IN EYE COLOR IN DROSOPHILA AND THEIR MODES OF INHERITANCE

The White Eye

In cultures of *Drosophila ampelophila,* that had been closely inbred for a year, a male fly, lacking the red pigment of the eye, appeared. The same stock has continued to produce these white-eyed mutants always of the male sex. A white-eyed father transmits the character to about one fourth of his grandsons, but to none of his granddaughters. In this sense the character is sex limited. The white eye can be transmitted, however, to the females, most readily by breeding any white-eyed male to red hybrids (F_1) out of white by red. White-eyed males and females give pure stock. When a white-eyed female is bred to any wild male all of the female offspring have red eyes and all of the male offspring white eyes. The result shows that the male-bearing sperm of the wild flies lacks at least one of the factors essential for the production of red eyes. This statement does not mean that the male-determining sperm lacks all of the factors essential for producing red, but only that it lacks one of the factors necessary for the production of red. In fact, it is conceivable that all of the rest of the cell may be equally essential for the production of red, but in the absence of one condition (factor) the red fails to develop. It is in this sense that I understand the use of the word "factor" in inheritance; and in the same sense one might employ the word "unit character," although the latter word may seem to imply (from usage) that a particular character is represented entirely by some unit in the germ cells. We are not warranted, I believe, in extending to the results of Mendelian inheritance such an interpretation. Since I have discussed elsewhere the mode of transmission of the white eyes,[1] I shall omit further details here.

The Pink Eye

This eye color has appeared at least twice in cultures in no way closely related to the white-eyed stock. It is not due to a cross between red- and white-eyed flies. The color is much lighter and more translucent than red, and appears to contain more yellow. It is seen to best advantage soon after the flies have emerged. Later it becomes darker and casual observation might mistake it for red. As the flies get old the pink changes to a somewhat purplish color, and this change does not take place in the red eyes, so that with experience there is no difficulty in separating the two colors at all stages. No intermediate condition has been seen despite the fact that thousands of the pink-eyed flies have been examined.

Pink-eyed males bred to wild red-eyed females produce all reds in the first generation. These flies, inbred, have produced in the second filial generation 3,063 reds to 169

[1] Science, July 22, 1910.

pinks, males and females. The reciprocal cross, viz., pink-eyed females and red-eyed males, gives also in the first generation red-eyed individuals only. These inbred have produced 1,133 reds, males and females; and 237 pinks, males and females. The results show that pink is not sex limited. The simplest explanation of the difference between the modes of inheritance of pink and white eyes is found, I think, if we ascribe the factor involved in the formation of pink eyes to some other part of the mechanism than that involved in the formation of white eyes. If I am right in ascribing the sex-limited inheritance of white eyes to some change in one of the sex chromosomes, then the factor for pink eyes must be contained in some other part of the cell; possibly in some other chromosome. That this must be the correct interpretation is borne out by the results of the second cross just given, in which the male-producing sperm of the red-eyed male produces red-eyed males. Evidently this sperm adds the necessary factor to the pink-bearing egg to produce red eyes, which would not be the case if the factor in question was present in the sex chromosome which is assumed to be absent from this spermatozoon. The hypothesis also makes clear how important it may be to recognize that different parts of the cell may be involved in producing such a "unit character" as eye color.

The relation of pink to white eyes is extremely interesting. When a pink-eyed female is bred to a white-eyed male all of the offspring have *red eyes*. These inbred produce red-, white- and pink-eyed offspring in the following proportions:

Red-eyed females	418
Red-eyed males	198
White-eyed males	222
Pink-eyed females	117
Pink-eyed males	35

White eyes appear again in this combination as sex limited. The pink eyes are relatively few in number, and the *females* are about three times as numerous as the males.

The reciprocal cross, viz., white-eyed females and pink-eyed males, gives in the first generation *red-eyed females and white-eyed males*. These inbred produce:

Red-eyed females	411
Red-eyed males	333
White-eyed females	377
White-eyed males	365
Pink-eyed females	76
Pink-eyed males	94

In this combination both males and females with white eyes appear in the second generation in about the same proportion as the red-eyed individuals. The pink eyes are again fewer than the other classes, but now the *females* are somewhat less numerous than the males. These peculiar results can, I believe, be accounted for theoretically, but the analysis is too elaborate to give here.

These results indicate that the white eye lacks one factor for red and pink eye, another factor for red. When combined all the elements for red are present. But the second generation shows that the reds formed in this way by recombination differ from the ordinary reds in that they produce reds, pinks and whites. The difference between these artificial reds and the normal reds consists in the presence of one dose of red in the artificial and two in the normal reds (at least in the female). The segregation is a consequence of this heterozygous condition. If this view is correct it should be possible to produce by the proper combinations some pinks and whites that when combined no longer produce reds, but only pinks and whites. I have made such races that have continued for several generations to produce pinks and whites only in very large numbers. In order to discover whether the induced change in this new race has taken place in the white or in the pink, the following experiment was carried out. One of the new pink females was crossed to a white male of the ordinary stock. This combination gave, it will be recalled, with ordinary pinks, red males and females, as stated above. The same thing occurred in the new experiment, showing that the pink had not been changed. On the other hand, when a white male of the new "pink-white" stock was crossed to an ordinary pink

female only pinks and whites were produced. Evidently the change has taken place in the white. If we express the ordinary red color as the outcome of two factors C and R then the *ordinary* whites will be OR while the *new* white will be represented by OO. The tests that I have made so far corroborate this view, giving the combinations expected from the formulæ. Theoretically the new white should behave towards the new pink as a sex-limited character in the same way in which the original white behaved towards the reds, and such, in fact, is the case. Moreover, it is clear why in the one case (white and pink) there should be sex-limited inheritance and in the other (red and pink) a different kind of inheritance, provided, as the facts strongly indicate, that the factor for pink is contained in another part of the hereditary mechanism than the factor for white. In other words, the factor for white (absence of red) is connected with the factor that determines sex, while that for pink is contained in a different part of the cell. It is this evidence that has seemed to me to show that the phenomenon of sex-limited inheritance is due to an intimate physical relation between the sex factors and the other factors in question; and the most obvious connection is that the relation is to be found in the chromosomes that carry both the sex factor and those factors that are sex limited.

The Bright Red Eye

This color arose in hybrids produced by breeding flies with miniature wings to wild stock. A small percentage of the male offspring had bright red eyes. This cross has been repeated a number of times and has always given some bright red-eyed flies. There can be little doubt that it is produced in some way by the cross. I found, it is true, one individual with bright red eyes in the wild stock from which the cross was made, but only once in many hundreds of flies examined, while the production of coral eyes is a constant feature of the hybrids.

The bright red eye is sex limited, as shown by the fact that in certain combinations it has appeared only in the males. When such males were bred to their red-eyed sisters, bright red-eyed females as well as males were produced. When two bright red-eyed individuals are mated they produce only bright red-eyed offspring, and I have a large stock of these flies that originated in this way.

The bright red eye differs from the red eye in being *conspicuously* more brilliant in color. No intermediate condition has been found. The relation between this color and red and pink has not yet been fully worked out.

The Orange Eye

A cross between a white-eyed male and a red-eyed female (heterozygous for pink) produced flies with red, bright red, pink, white eyes, and a few flies with eyes having a faint orange tinge. The eyes are much lighter than pink eyes, and do not seem to intergrade with them. The appearance of the orange color in this and in other cultures followed the appearance in them of the bright red eye, and seems to be connected with the factor for bright red. As yet this relation has not been clearly worked out. Orange bred to orange has given in some cultures stock that has produced many hundred flies with orange eyes only. The orange eye has not been found to be sex limited in any of the many combinations that have so far been made. Thus while white and bright red eye colors are sex limited the other two colors, pink and orange, do not show this form of inheritance. Now that pure cultures of all the stocks have been obtained, their interrelations will be further studied.

The Spotted Eye

On two or three occasions flies appeared in which some of the ommatidia of the compound eye were red and the rest white. The last individual of this kind that appeared was obviously a white fly with about one fourth of the area of one eye red, the rest white. The other eye was entirely white. Unfortunately the fly died before she could be tested. The occurrence of this mutation is of interest in its bearing on the origin of the spotted condition in many of our domesticated animals.

These cases are comparable to heterozygous flies with one long wing and one short,

proportionate—one the dominant, the other the recessive type. Two such flies have been bred to the recessive form and have given long- or short-winged offspring—no fly with both types of wing. Inbreeding these longs to shorts again has not yet produced a single fly with both types of wings. Evidently the asymmetrical condition is due to a somatic change that takes place in the development of the individual; a change comparable to that that takes place in the germ cells of Mendelian hybrids. The same explanation applies to the case of the spotted eyes also. The spotted condition appears therefore to be an ontogenetic segregation.

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HEREDITY IN INSANITY

THE fact that nervous and mental diseases are often transmitted by heredity was known to Hippocrates and has since his time been amply illustrated by insane-hospital statistics. but the exact conditions under which such transmission occurs have never been fully understood. A recent study has, however, revealed some data which seem to indicate that certain forms of insanity are transmitted from parent to offspring in the manner of a trait which is, in the Mendelian sense, recessive to normal.[1] The accompanying table shows the actual findings recorded in the study here referred to; these findings, it will be observed, are in fairly close correspondence with theoretical expectation, which is as follows:

1. Both parents being neuropathic, all children will be neuropathic.

2. One parent being normal, but with the neuropathic taint from one grandparent, and the other parent being neuropathic, half the children will be neuropathic and half will be normal but capable of transmitting the neuropathic make-up to their progeny.

3. One parent being normal and of pure normal ancestry and the other parent being neuropathic, all the children will be normal but capable of transmitting the neuropathic make-up to their progeny.

4. Both parents being normal but each with the neuropathic taint from one grandparent, one fourth of the children will be normal and not capable of transmitting the neuropathic make-up to their progeny, one half will be normal but capable of transmitting the neuropathic make-up, and the remaining one fourth will be neuropathic.

5. Both parents being normal, one of pure normal ancestry and the other with the neuropathic taint from one grandparent, all the children will be normal, half of them will be capable and half not capable of transmitting the neuropathic make-up to their progeny.

6. Both parents being normal and of pure normal ancestry, all the children will be normal and not capable of transmitting the neuropathic make-up to their progeny.

Types of Mating	Number of Matings	Total Offspring	Neuropathic Offspring	Normal Offspring			Died in Childhood	Data Unascertained
				Neuropathic Progeny	Without Progeny	Normal Progeny		
RR × RR ∞ RR	3	16	10	0	0	0	5	1
DR × RR ∞ DR + RR	19	129	45	14	20	27	20	3
DD × RR ∞ DR	5	18	0	8	2	7	1	0
DR × DR ∞ DD + 2DR + RR	7	54	12	6	18	10	8	0
DD × DR ∞ DD + DR	1	4	0	1	0	3	0	0
DD × DD ∞ DD	0	0	0	0	0	0	0	0

D = Dominant. R = Recessive.

RR = Neuropathic subject (nulliplex inheritance).

DD = Normal subject of pure normal ancestry (duplex inheritance).

DR = Normal subject with neuropathic taint from one parent (simplex inheritance).

[1] "Preliminary Report of a Study of Heredity in Insanity in the Light of the Mendelian Laws," by G. L. Cannon and A. J. Rosanoff. Read before the New York Neurological Society, October 4, 1910.

Results similar to those recorded in the table here given have been obtained in a much more extensive study of heredity in feeble-mindedness which was recently reported by Goddard.[2]

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THE TEXAS-CALIFORNIA ARC OF PRIMARY TRIANGULATION

A great arc of primary triangulation more than 1,200 miles in length, extending from central Texas to the Pacific coast, has just been completed by the Coast and Geodetic Survey. It connects the 98th meridian primary triangulation in the vicinity of Weatherford, Texas, with the Pacific coast primary triangulation in the vicinity of San Diego, California.

It is connected with the United States and Mexican Boundary at a number of places and is joined to and correlates a number of detached government surveys. It furnishes the geographic positions on the U. S. Standard Datum, of more than two hundred points which can be used to control all future public surveys within the region traversed.

There are 92 primary stations in the main scheme of this triangulation and, in addition, 38 stations in secondary schemes which provide for the connections with United States-Mexican boundary monuments and existing triangulation. The total area covered by the triangulation is 48,400 square miles, the average length of line east of El Paso is 17 miles, and from that place to the Pacific coast it is 62 miles. The maximum length of line is about 120 miles. The observations were made with a 12-inch theodolite, the pointings being made on heliotropes and acetylene lamps mounted at the stations observed upon. During the progress of the triangulation two primary bases were measured and 24 primary azimuths were observed.

The reconnaissance for this work was made between September, 1907, and February, 1908, and the observing was done in three seasons between November, 1908, and February, 1911. The total work was done in less than three years and six months, and the observations in less than two years and four months.

While the Coast and Geodetic Survey has, in the past, made more rapid progress on primary triangulation in the United States than that made in any other country, yet the rate of progress on the Texas-California arc exceeds that on any other arc in this country and the unit costs per square mile of area covered by the main scheme and per mile of progress are only about one half those of the triangulation between Marysville, Cal., and Tacoma, Wash., the arc for which, previously, these unit costs were the lowest. The accuracy, as measured by the closing errors of triangles of the Texas-California arc, is greater than that specified in the requirements for such work.

The remarkable rapidity of progress and the low cost of the work were largely due to the small amount of camp equipage used by each unit of the party; to the fact that only two officers had charge of field work, the writer on reconnaissance and a portion of the first season's observing, and Mr. J. S. Hill on the remainder of that season's work and that of the succeeding two seasons; and to the services of a most efficient signalman, Mr. J. S. Bilby, who was attached to each party from the beginning of the reconnaissance to the end of the observing. The parties were organized and managed, in the main, in a manner similar to that of the parties engaged on other pieces of primary triangulation done by this survey in recent years, only such changes being made as were necessary to meet new conditions which were encountered in semi-arid and arid sections, much of which was also mountainous.

This arc of primary triangulation will not necessarily be discussed separately by this survey in investigations of the figure of the earth, as were the two great arcs, one extending across the continent along the 39th parallel of latitude and the other paralleling the Atlantic coast from Maine to the Gulf, and known, respectively, as the "transcontinental arc" and

[2] *Amer. Breeders Magazine*, Vol. I., No. 3.

the "oblique arc." In the last two publications by the Coast and Geodetic Survey on investigations of the figure of the earth (entitled, "The Figure of the Earth and Isostasy from Measurements in the United States" and "A Supplementary Investigation in 1909 of the Figure of the Earth and Isostasy") the method was adopted of using the entire connected network of triangulation.

WILLIAM BOWIE,
Inspector of Geodetic Work
COAST AND GEODETIC SURVEY

THE ITHACA MEETING OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS, DECEMBER 28–30, 1910

Bacteriology in General Education (president's address): V. A. MOORE.

This address is printed in full in SCIENCE, February 24, 1911. (Secretary.)

A Bacteriological Museum and Bureau for the Exchange of Bacterial Cultures at the American Museum of Natural History, New York: C. E. A. WINSLOW.

The Department of Public Health at the American Museum of Natural History has equipped a laboratory to serve as a central bureau for the preservation and distribution of bacterial cultures of both pathogenic and non-pathogenic organisms, and particularly of types of new forms and varieties. It is hoped that the laboratories of medical schools, colleges, boards of health, agricultural experiment stations, etc., and those engaged in biochemical work of all sorts, will furnish the museum with cultures at present in their possession, and the laboratory is now ready to receive and care for all such cultures. It is desired to have the history of the organisms in as full detail as possible and the museum will be glad, where necessary, to pay for the expense of transferring cultures and transcribing records. Types of new species and varieties are particularly desired at the present time and as they may be isolated in the future.

The laboratory plans also to keep on file descriptions of bacterial species in print or arranged in the form of the standard card and will be grateful for copies of any such descriptions.

Descriptions filed in the department will be carefully preserved and living cultures will be kept in good condition, so far as possible, and will be supplied to corresponding laboratories and schools and other institutions which may desire cultures. The laboratory, of course, can not undertake to keep on hand difficultly-cultivable organisms, such as can only be maintained for a few weeks after isolation from the body; neither can it at present supply virulent cultures of organisms which rapidly lose their virulence under laboratory conditions. It should, however, be able to furnish cultures of organisms of all the ordinary types, which can be maintained under cultivation. Pathogenic forms will only be sent to properly qualified persons.

It is hoped, further, that the laboratory may offer opportunities for work in systematic bacteriology, and facilities will be offered to properly trained workers who may desire to conduct such work at the museum or to obtain cultures for carrying it on elsewhere.

The Proposed Microbiological Central Station in Berlin: OTTO RAHN.

This paper consisted of a review of the efforts put forth in Germany to establish a central station for investigations and distribution of microbiological cultures. It was in line with the preceding paper, but indicates that the German policies are more extensive and complete. (Secretary.)

The Fermenting Capacity of the Average Individual Cell (Bacterium lactis acidi): OTTO RAHN.

It is possible to compute approximately the amount of metabolic products formed by one bacterial cell in one hour. This unit is called "fermenting capacity." Object of this computation is the separation of the two vital factors of microbial activity, the growth and the fermentation. At present, this separation can be accomplished only by a mathematical calculation. The fermenting capacity of the average cell is approximately given by the equation:

$$X=\frac{S \log b/a}{t\,(b-a)\log^2},$$

where S is the amount of products formed during the time t, a is the number of cells in the beginning, b the number after t hours. The fermenting capacity of the average cell of *Bacterium lactis acidi* is about 0.000,000,001 to 0.000,000,004 mg. of lactic acid per hour. This amount is of the same order of magnitude as the weight of the cell.

Old cultures of *Bacterium lactis acidi*, if transferred into fresh milk, ferment very slowly because the power of multiplication as well as the

fermenting capacity are greatly reduced, both in about the same ratio. Increase of temperature stimulates growth and fermenting capacity. The comparison of a milk culture and a lactose broth culture showed a higher rate of growth in milk, a higher fermenting capacity in broth. Oxygen reduced the total amount of acid produced and in the two strains under study, the fermenting capacity is more influenced than the growth. It was found that transferring in sugar-free broth for 32 days in succession did not influence the fermenting capacity at all.

The frequent statement that in young cultures growth takes place without fermentation is not based on actual experiments. The amount of products formed by a small number of cells must necessarily be so insignificant that it can not possibly be detected by chemical analysis. From the time when a chemical proof is possible, the parallelism is evident. There is no indication of a discontinuity. This is proved, however, only for true products of fermentation. Toxins may be secondary products and follow other laws.

A Halophytic Diplococcus: T. D. Beckwith.

During the summers of 1907 and 1910 the principal cause of the reddening during preparation for market of salted codfish and other gadoid fish appeared to be a diplococcus which could not be isolated by use of standard media. Special media were devised, the first being an infusion of ordinary salted and unpreserved shredded cod flesh (100 parts) with distilled or rain water (1,000 parts) with the addition of 2 per cent. agar-agar. The second medium was made by using pickle from the butts diluted once with distilled or rain water and with 2 per cent. agar-agar added. The NaCl content of these media averaged 5.25 per cent.

Upon these media at 30° C. in 96 hours salmon-pink colonies appeared upon plating out pinkened fish flesh. The predominant colony form was a diplococcus. This coccus is 0.4–0.5 μ in diameter in freshly isolated cultures; later upon repeated transfer during two years' time, it showed swollen involutionary forms sometimes 1.0 μ in size. The adjacent sides of the units of the diplococcus are slightly flattened like the gonococcus. It stains easily with all common formulæ such as carbol-fuchsin and methylene blue. It is Gram positive; non-motile, although having a very marked brownian motion. No capsule could be demonstrated, although the colony on immersion in water showed slight zooglœa-like characteristics. It is an obligatory aerobe. Colony is 1–2 mm. in diameter with edge slightly raised. In chromogenesis the colony is salmon pink but color is somewhat lessened after repeated transfer, becoming pinkish white. In pure culture feeble growth appears on standard neutral beef agar but is not fostered by the other common media in vogue.

No description could be found of this diplococcus and it is thought to be a new species. As it appears on the salt flesh of practically all members of that family, the name of *Diplococcus gadidarum* n. s. is proposed.

Later it was demonstrated that sometimes the form may be isolated on A.P.H.A standard beef agar plus 7–10 per cent. NaCl. Such a method is not at all certain in result, however.

On account of the fact that fish acted upon by this form undergo rapid decomposition due to its effects, and its characteristics are so halophytic tests were made to compare its growth in a saline medium with two most common forms of albuminous disintegration, *B. subtilis* and *B. fluorescens liquefaciens*. The sets of media were prepared by the addition of various per cents. of NaCl to A.P.H.A. standard beef agar with neutral reaction. Plates were incubated 96 hours at 30° C. The following table shows the points of repression of growth of these microorganisms upon such media and demonstrates the strong halophytism of this diplococcus.

Per cent. of NaCl	0	1	2	3	4	5	6	7	10	12.5	15	20
Diplococcus gadidarum	+	+	+	+	+	+	+	+	+	+	+	0
Bacillus subtilis	+	+	+	+	+	0	0	0	0	0	0	0
Bacillus fluorescens liquefaciens	+	+	+	+	+	0	0	0	0	0	0	0

Optimum condition for *Diplococcus gadidarum* n. s. is indicated to be 5–10 NaCl, for *B. subtilis* and *B. fluorescens liquefaciens* 0–1 per cent.

At Gloucester and afterwards in our laboratories, repeated smear preparations made from particles of fish flesh taken from the most reddened portions along the vertebræ where the coloring is most prominent and generally makes its first appearance, showed this diplococcus to be the most prominent form. It seems likely then that this diplococcus is one of the most destructive

agencies in the reddening of prepared salted fish. During the seasons of 1907 it was predominant on the samples examined, although it is possible to conceive that varying seasonal conditions of different summers may change the predominant form so that some other one of the various microorganisms as the causal factors of "red fish" may become the most destructive ones. This question is worthy of further study.

Bacterial Flora in Milk: H. W. CONN.

A general résumé of the present status of dairy bacteriology was furnished by this paper; and it also touched upon the significance of bacteriology in the control of municipal milk supplies. (Secretary.)

Relation of Form of Milk Pail to Germ Content of Milk: H. A. HARDING and J. K. WILSON.

The first important infection of milk occurs during the act of milking.

Ordinary milk pails have open tops, 12 or more inches in diameter. Many improved pails have been suggested, but few have been favorably received by dairymen.

The leading causes for rejection are the excessive height of the pails and the inconvenient size and shape of the opening for receiving the milk.

Tests of various pails indicated that a successful pail should not be over 12 inches high and should have an opening of approximately 25 square inches. An oval or elliptical opening is more convenient than a round one of the same area.

Stocking found that the use of cloths or mechanical strainers on pails was not desirable and that the relative efficiency of small-topped pails was greater under poor dairy conditions.

Under high-grade dairy conditions when a good small-topped pail was contrasted with an ordinary 18-inch open pail the reduction in germ content was more than 50 per cent. As such a pail is as convenient to use and practically as cheap as an ordinary pail, there seems to be no reason why it should not be generally adopted.

The Influence of the Products of Lactic Organisms upon Bacillus typhosus: Z. NORTHRUP.

This study was taken up first from the standpoint of the longevity of *B. typhosus* in sour milk. Previous investigations show that the typhoid bacteria in infected milk are generally all killed within twenty-four hours after the milk has reached 0.4 per cent. lactic acid.

Several widely varying types of lactic organisms were obtained from various sources for this study; *B. typhosus*, from the laboratory stock culture. The typhoid bacteria and a lactic-acid producer were grown together in sterile milk after the milk had soured; the combined culture was plated at intervals. A special plating medium was used in two succeeding tests for differentiating the typhoid and lactic organisms; one lactic only was inhibited by the bile agar used as a differentiating medium.

Assuming that it is the products of the lactic bacteria and not the bacteria themselves which exert the inhibitive influence upon the typhoid bacteria, the plan was formulated of growing the typhoid bacilli in their products alone. The lactics were grown in lactose broth, allowed to produce an amount of acid, then filtered through a Chamberland "F" bougie. As a result of these experiments, it was found that a certain amount of the acid produced by the typical lactic organisms has greater germicidal properties than the same amount produced by any other type of lactic organism. The typical lactic kills *B. typhosus* at + 37° acid or 0.3 per cent. lactic acid while the acid made by *B. bulgaricus* and another strong acid-producer reaches nearly twice 0.3 per cent. lactic acid in the lactose broth before the typhoid organisms are killed.

A comparison was made establishing the relative amount of acid produced in lactose broth and milk by lactic organisms. According to these results, + 37° acid, the minimum inhibitive acidity, produced by No. 2 in lactose broth, corresponds to + 80° acid or 0.72 per cent. acid in milk.

Summarizing, if strong lactic organisms are present in large numbers in infected milk, it may be definitely stated that all typhoid bacteria will be killed when the acidity in the milk reaches 0.72 per cent. lactic acid.

The Use of Fermentation Tests in the Study of the Lactic Bacteria: L. A. ROGERS.

It was found that the characters used in describing the lactic bacteria are not distinctive or are too variable to separate this group into subgroups.

The curdling of milk is especially variable and uncertain.

The fermentation of various test substances was found to be constant and, when properly correlated, to indicate natural grouping.

By means of these tests it was possible to separate the 150 cultures studied into three groups. Each of these groups was distinguished by fermenting or failing to ferment certain groups of test substances.

The Normal Number of Body Cells in Cow's Milk: R. S. Breed and I. Read Stedger.

A report on some determinations made at Allegheny College and the University of Göttingen by the use of the direct method of counting these cells devised by Prescott and Breed.[1] A series of examinations was made of cream and skim milks obtained in a variety of ways to determine what became of these cells when the milk was separated or centrifuged. The results obtained were so variable that the final conclusion was that none of the methods using the centrifuge can be made satisfactory enough to give results of any value so far as determining the number of cells present is concerned. A necessary corollary of this conclusion is that all the deductions based on the use of these methods, careful and painstaking as much of this work has been, are worthless so far as they are based on the numerical factor alone. A daily examination of the milk of three normal cows extending over a period of six weeks indicates that there may be a cyclic variation in the number of these cells and showed variations in numbers ranging from 0 to 20,000,000 and more in milk which was apparently normal in every particular.

What is the Value of Quantitative Bacteriological Determinations in the Control of City Milk Supply: H. A. Harding.

Their educational value is slight because dairymen are unable to translate quantitative results into terms of dairy processes and laboratory workers are also unable to do this until they have located the particular difficulty by other means.

As legal standards quantitative results have little value because they fluctuate so widely, dependent upon the technique used. A variation of 100 per cent. is frequently observed between the results of two equally accepted methods of determination.

They are not necessary, since the best results in improvement of city milk supply can be obtained without the aid of quantitative determinations.

They are useful as a check upon the work of dairy inspectors and in determining which dairies are most in need of close observation. Where the force of inspectors is not adequate to a close supervision of all the dairies, bacteriological determinations will indicate where the inspector's energy can be most wisely employed.

Their greatest value is in measuring the sources of infection. There is at present a lack of much data and thousands of dollars are being wasted in present attempts at producing sanitary milk because the relative importance of various avenues of infection are not understood.

[1] See *Journal of Infectious Diseases* for 1910.

Apparatus for Collection of Deep-water Samples: Payn B. Parsons.

Description of a sampling apparatus for use in collecting samples of water for bacteriological examination, where the depth of water is very great and the currents are strong.

A single rope used for lowering and raising the lead pipe container and for breaking off the neck of the vacuum tube or releasing the stopper.

Also a description of an apparatus for the collection of chemical samples and one especially adapted for dissolved oxygen samples, where the samples must be taken in very deep water and the line kept plumb in the currents.

Bacteria in the Waters of New York Harbor: Payn B. Parsons.

Table giving the average number of bacteria in the water of New York harbor at the surface and at the bottom during 1909.

Table giving the average number of bacteria in the water of New York harbor during ebb and flood tides during 1909.

Averages of 1,082 examinations of water, made for the Metropolitan Sewerage Commission of New York, are included in the tables.

Discussion of present dangers to the health of the people from the vast quantity of sewage dumped into New York harbor, with special reference to bathing and the oyster industry.

Intensity of Pollution as shown by Numbers of Bacteria: Payn B. Parsons.

A consideration of numbers of bacteria in various sections of New York harbor, including a comparison of the numbers occurring in samples collected in the Atlantic Ocean and in those taken at points where there was a high degree of pollution.

Summary of the average number of bacteria in each distinct section of the harbor, during ebb and flood tides.

Table showing average numbers of bacteria as compared with the average per cent. of saturation with oxygen in the water of the various sections of New York harbor for all depths and tides during 1909. Eight hundred oxygen and 1,082 bacterial analyses, made for the Metropolitan Sewerage Commission of New York, are included in the averages.

Comparison of numbers of bacteria in mud deposits on the harbor bottom in samples collected from polluted and unpolluted sections.

Relation of channels and shoals to bottom deposits and bearing of this upon the oyster industry.

Biochemical Factors in Soil: M. X. SULLIVAN.

The soil is not an inert reservoir for plant food, but is the seat of physical, chemical and vital actions, the biochemical factors being especially prominent. Numerous bodies which occur in soils and arise either in the metabolic activities of microorganisms or are left in the soil after the decomposition of the plant and animal débris and perhaps occur also as a result of excretion from roots or from cell sloughing, play a considerable rôle in soil fertility. Some of these substances are harmful to plants, some beneficial. Fertilizers do work in soil in modifying the physiological functions of the microorganisms by bringing about suitable conditions for their development, in stimulating or retarding their digestion of inert bodies, and in furthering their enzymotic functions. Soils *per se* have oxidizing and catalyzing properties, while poor soils have these functions in a much lessened degree. Oxidation in subsoils which are of much poorer productivity than the surface soil is usually very slight.

Bacteria of Frozen Soil: H. J. CONN.

Results of work at Ithaca, N. Y., during 1909–10, showing a phenomenal increase in soil bacteria during the winter. Quantitative results already published.[2] Qualitative work includes the study of about 300 cultures.

Quantitative Results.—Increase from 7 millions per gram in November, 1909, to 33 millions in February, 1910, and from 8 in November, 1910, to 22 in December, 1910. These results are new, but are not disproved by previous work.

Possible Explanation.—There seem to be two different groups of organisms, one increasing in warm, the other in cold weather; the former requires so much organic food that a rapid increase is impossible.

Evidence in Support of this Explanation—

Relation to Moisture Content.—Germ content and moisture content are usually parallel; the exceptions to this rule are such as to suggest an alternation in predominating types.

Relative Numbers of Rapid Liquefiers, Actinomycetes and *Slow Growers.*—The last group increases in winter.

[2] *Centbl. f. Bakt.*, II. Ab., 28, pp. 422–434.

Qualitative Results.—There are certain organisms present throughout the year. The others appear only at times and show a tendency to reappear at the same season another year. Fall and winter show the greatest diversity of types.

Classification of the types studied in this work:

1. Higher filamentous bacteria. Actinomyces.

2. Rapid liquefiers, producing spores. Mostly of the *B. subtilis* group.

3. Rapid liquefiers, without spores. All but one *Pseudomonas* forms.

4. Slow growers—without spores, producing punctiform colonies; partly show liquefiers, partly non-liquefiers.

Medium used in quantitative work: Gelatin, 12 per cent.; dextrose, 0.1 per cent.; soil extract, 20 per cent. Reaction adjusted with NaOH to 0.5 per cent. acid to phenolphthalein. Soil extract for this medium prepared by boiling 30 minutes with an equal weight of water, then filtering.

Incubation period in quantitative work: 7 days. Temperature of incubation: 19°.

Viability of P. radicicola on Ash-maltose-agar: S. F. EDWARDS.

During the summer and autumn of 1906, cultures of *P. radicicola* were isolated from the nodules of nineteen hosts, an ash-maltose-agar. Colonies were transferred to the same medium in Freudenreich flasks which were kept in a darkened cupboard at laboratory-room temperature. During the autumn of 1910, plates were made from these old cultures with the result that in fifteen of them the organism was still living. The results are shown in the following table:

In every case in which growth occurred, the colonies were typical, and stained preparations and hanging drops showed the typical characters of *P. radicicola.*

Pot tests in sterile sand were started, using seeds of alfalfa, red clover, peas and beans. At the time of writing, only the peas were sufficiently developed to examine. Of six control plants, not inoculated, three showed no nodules, and three showed 1, 10 and 12 nodules, respectively. Six plants inoculated with the 1906 culture showed 18, 33, 20, 25, 64 and 25 nodules, respectively. Stains from the nodules showed rod and branched forms typical *of P. radicicola,* and plates showed abundant growth in five days on ash-maltose-agar at room temperature. The work thus far shows evidence that *P. radicicola* retains its virility as well as its vitality after considerable periods of time in stock cultures under laboratory conditions.

Viability of P. radicicola on Ash-maltose-agar

Host Plant	Alive after		
	Years	Months	Days
Siberian pea tree (*Caragana frutescens*)	4	4	4
Red clover (*Trifolium pratense*)	4	5	0
Soy bean (*Glycine hispida*)	No colonies on ash-maltose-agar.		
Sweet pea (*Lathyrus odoratus*)	4	0	10
Garden pea (*Pisum sativum*)	4	2	17
Alsike clover (*Trifolium hybridum*)	4	3	21
Bitter vetch (*Lathyrus sativus*)	4	4	16
Flat pea (*Lathyrus sylvestris*)	No colonies on ash-maltose-agar.		
Red clover (*Trifolium pratense*), isolated from dried plants sent from Medicine Hat, Alta.	3	10	16
Alfalfa (*Medicago sativa*)	4	2	9
Black medick (*Medicago lupulina*)	4	4	16
Horse bean (*Vicia faba*)	4	0	29
Black locust (*Robinia pseudocacia*)	No colonies on ash-maltose-agar.		
Honey locust (*Robinia viscosa*), medium dried to 7 mm. from 28 mm	4	4	12
Dutch white clover (*Trifolium repens*)	4	3	20
Garden bean (*Phaseolus vulgaris*)	4	1	0
Scarlet runner bean (*Phaseolus multiflorus*)	No colonies on ash-maltose-agar.		
Hairy vetch (*Vicia villosa*), medium dried to 4 mm. from 24 mm	3	11	22
Sweet white clover (*Melilotus alba*), medium dried to 4 mm. from 24 mm	4	4	14

Studies of Media for the Quantitative Estimation of Bacteria in Water, Sewage, etc.: Stephen Dem. Gage.

The Variation in Composition of Beef Infusion.—In a former report, the writer called attention to the fact that the variation in the amount of solids in beef infusion made by the standard procedure was as great as or greater than the amount of pepton added in the process of making gelatin or agar media from that infusion. At that time (1904) it was suggested that this error might be considerably reduced if the beef infusion were made up to a constant specific gravity. The records at the Lawrence Experiment Station show that while the specific gravity of coagulated and filtered beef infusion prepared according to the standard procedure, may vary between 1.100 and 1.005, about one half of the samples have a specific gravity of about 1.006, and this value was selected as a standard. Analyses of a large number of samples of beef infusion adjusted to a standard specific gravity of 1.006 show that the range of variation in the total nitrogen and in the total organic and mineral matters in solution has been fully as great as when no correction of the specific gravity was attempted. The error in reading specific gravity with a hydrometer may be as much as ten per cent. A careful analysis of the records shows that the proportion of samples in which the total solids did not vary more than 10 per cent. from the mean was increased from about 55 per cent. in the case of samples of the usual beef infusion to over 75 per cent. in the samples of infusion with a constant specific gravity, and a similar increase in uniformity is found in the total organic matters and in the total nitrogen. In other words, the use of beef infusion of a constant specific gravity is a step toward media of more uniform composition, and toward increased accuracy in bacterial counts.

The Influence of Quartz Sand upon Microbial Cultures: Otto Rahn.

The object of this paper is to study the influence of soils upon microorganisms. The decomposition of liquid media (milk, peptone solution) was compared with that of the same liquid absorbed in quartz sand, and great differences were found. Naturally, aerobic processes were greatly increased and anaerobic processes greatly decreased when the liquid was mixed with sand in such proportion as to allow of abundant aeration. Both aerobic and anaerobic processes were favored, however, when just enough liquid was added to the sand to keep it entirely submerged. This indicates a peculiar influence of the quartz sand upon microbial action which is paralleled by the retardation or inhibition of poisonous effects upon plant roots by mere addition of quartz sand. Surface attraction of the microbial products by quartz sand does not account for this phenomenon.

Studies in Disinfection of Alfalfa Seeds: J. K. Wilson.

Sterile seeds are desirable if not necessary for the study of the relation of bacteria to plant life.

Sterile legume seeds may be obtained from ripening pods, but occasionally they are needed when such a supply is not at hand.

The utility of alcohol, corrosive sublimate and formaldehyde in providing such a supply has been tested on alfalfa seeds.

Sterility of seeds so treated was tested by incubating them in standard bouillon and examining them macro- and microscopically.

Seeds immersed in 70 per cent. alcohol for 105

minutes were not sterile. The effect of this treatment on germination was not tested.

Immersion in $HgCl_2$ 1–1,000, for 2 minutes and washing eleven times in sterile water did not result in sterility. This treatment did not reduce the percentage of germination of the seeds.

Seeds immersed in 10 per cent. formaldehyde for 80 minutes were sterilized only in a few instances. The germination was reduced 3 per cent.

Seeds were first put into 95 per cent. alcohol for 10 minutes and then into 10 per cent. formaldehyde for periods ranging from 15 minutes to 6 hours. Only those treated 6 hours in formaldehyde were sterile. The germination of the seeds treated 6 hours was reduced 65 per cent. Ten minutes in alcohol did not reduce the percentage of germination.

Seeds were first put into water in a vacuum chamber and the pressure reduced to 3 mm. for 210 minutes. A portion of these seeds, after being placed for 30 minutes in 10 per cent. formaldehyde, was sterile, but the seeds did not germinate. The vacuum treatment alone did not reduce the percentage of germination.

Apparently the air in seeds prevents the entrance of disinfecting solutions and protects the bacteria.

Method of Keeping Bacteria from Growing Plants: J. K. WILSON and H. A. HARDING.

The main avenue of infection for experimental plants is through the air.

Of the many ways which have been suggested for preventing this infection none of them are simple and effective.

Harrison and Barlow have published on a method for growing legumes on agar in Erlenmeyer flasks. This method can be improved by growing plants in sterile Mason jars, using sterile seeds and earth. Exchange of gases is provided for by soldering a ½-inch tube into the metal jar top, plugging the tube with cotton and covering it with an inverted test tube to reduce the chances of contamination and to check evaporation.

Alfalfa planted in such jars, in sterile sandy soil to which 10 per cent. of water has been added, grew thriftily during four months without being watered or the jars being opened.

(The jars exhibited contain alfalfa planted August 13, 1910, and the jars have not been opened since that date.)

Bactericidal Properties and Variations in the Agglutinin Content of Antimeningococcic Sera: LAWRENCE T. CLARK.

Serum obtained from the horse which has received subcutaneous injections of first modified and later unmodified polyvalent suspensions of the meningococcus, acquires measurable quantities of agglutinin. Intraperitoneal injections of similar suspensions, either mono- or poly-valent, produce in the ram a serum of markedly greater agglutinating power.

Homologous sera produced from six cultures respectively, by intraperitoneal injections in the ram, gave distinctly specific agglutinative reactions with but one exception—sera 4 and 6 and cultures IV. and VI. being interchangeable with similar results.

Polyvalent antimeningococcic ram serum possesses decided bactericidal activity, as demonstrated by its effect in combination with complement on fresh living suspensions of the meningococcus.

Studies on Immunity in White Rats and Mice against Spirochæta duttonii: D. H. BERGEY.

White rats and mice that have recovered from a well-marked infection with *Spirochæta duttonii* have a high degree of acquired immunity against the organism. The serum of such immune rats and mice serves to protect normal animals against the infection.

The degree of immunity developed is not always absolute, though it is always sufficient to induce a pronounced alteration in the severity and course of the infection. If infection occurs, the onset is delayed, the number of organisms in the blood is relatively small, relapses are infrequent, and a fatal termination of the disease is prevented.

The protective substances in the blood of the immune animals consist of at least three types of antibody. Agglutinins are present early in the disease. Bacteriolytic substances are developed as shown by the degenerative changes in the organisms toward the close of the disease. Besides these tropic substances are undoubtedly of far greater importance in bringing about the very rapid diminution in the number of organisms in the blood.

The final elimination of the organisms from the blood of the infected animals rests upon their englobement by the free and fixed cells of the body through the influence of the tropic substances.

Agglutination of B. choleræ suis during the Production of the Dorset-Niles Serum: WARD GILTNER.

Purpose.—An effort has been made to throw some light upon the relation between *B. choleræ suis* and hog cholera. There has also been considered the possibility of a constant relationship between potency of serum and agglutinative power for *B. choleræ suis.*

Methods.—The macroscopic, test-tube method has been followed. Cultures were isolated from the spleen of virus hogs. At first a bacterial suspension was prepared by washing off surface growth from agar slants with carbol-salt solution, later bouillon cultures were diluted with a solution of formaldehyde. Blood samples were taken from the tail bleedings or at slaughter or death of pigs. Samples of "mixed sera" were preserved in .5 per cent. phenol generally.

Results.—Normal blood serum gave a maximum reaction at a dilution of 1–250 or less.

Blood of virus pigs gave a maximum reaction at a dilution of 1–800, but usually less.

Blood of pigs treated by the serum-simultaneous method gave a maximum reaction at a dilution of 1–500. These pigs were younger than the virus pigs and, other things being equal, young pigs generally possess a blood of less agglutinative power than old pigs.

The agglutination reaction appears to be a reaction of immunity since, as a rule, pigs treated by the serum-simultaneous method possess a blood of higher agglutinative power if they live (develop immunity) than if they die (fail to develop immunity).

During the process of hyperimmunization agglutinins for *B. choleræ suis* increase as the virus injections increase, but not necessarily simultaneously or in the same degree.

Of 51 samples of Dorset-Niles serum, only 11 gave an agglutination reaction at a maximum of 1–1,000 or less, while 7 agglutinated at 1–50,000.

The agglutinative power of a mixed serum may decrease more or less than 50 per cent. after 6 to 8 months in cold storage.

Potency of serum can not be measured by agglutinative power in all cases.

Sera of high agglutinative power, *i. e.*, agglutinating at 1–2,000 or above, were potent in 85.71 per cent. of cases and not potent in 14.28 per cent.; sera of low agglutinative power, *i. e.*, agglutinating at 1–1,000 or less, were potent in 45.45 per cent. of cases and not potent in 54.54 per cent.

Studies on the Filterable Virus of Hog Cholera: Chas. T. McClintock, Walter E. King and Robt. H. Wilson. (From the Research Laboratories of Parke, Davis and Co., Detroit, Mich.)

Results of experiments indicate that a relatively short residence of hog-cholera serum in the circulatory system of the horse, in some way causes an activation of the virus. Horse serum, obtained one half to one hour after the animal has received approximately 140 c.c. of hog-cholera virus, is capable of producing more uniform results when injected into healthy hogs than corresponding dilutions of hog-cholera serum in normal horse blood, *in vitro,* and in physiological salt solution. The incubation period following the injection of horse-serum virus is relatively short.

The minimum fatal dose of virulent serum, as represented by a dilution of the virus in physiological salt solution, does not appear to indicate the minimum fatal dose where the dilution is maintained in the form of horse-serum virus.

From some analogous phenomena relative to the behavior of toxins, it is suggested that the filterable virus of hog cholera may contain a distinct toxin portion.

A Discussion of the Preparation and Distribution of Biologic Products: J. J. Kinyoun.

Founded upon the experiences of the author who has been intimately connected with the development in the production of biologic products in the United States, certain inductions of wide application were drawn pointing toward municipal and governmental manufacture and control. (Secretary.)

Intestinal Bacteriology: A Résumé: Arthur I. Kendall.

By feeding experimental animals (cats and monkeys) alternately with protein and carbohydrate, respectively, it is possible to demonstrate definite alternations in the intestinal flora both by staining and by cultural methods.

These bacterial alternations consist essentially of a definite sequence of proteolytic and fermentative types of organisms. In addition to these changes in the type of the intestinal flora as the diet of the host is alternated, certain bacteria are able to accommodate their metabolism to a protein and a carbohydrate regimen, respectively. For example, *B. coli* possesses the power of accommodating its metabolism both to a protein and to a carbohydrate diet.

This accommodation of metabolism to dietary changes is a fundamental and extremely important property possessed by many bacteria, and it can be utilized therapeutically.

In lactic acid therapy it plays a prominent rôle: feeding carbohydrate and cutting down protein in patients suffering from the absorption of protein putrefaction products leads to a change in the metabolism in many of the prominent bacteria concerned in the morbid process. These organisms attack the sugar in preference to protein, since it has been shown by the writer that fermentation takes precedence over putrefaction in these bacteria.

In exogenous infections, such as bacillary dysentery, it also is an important feature, since it is possible to influence favorably the associated bacterial flora by feeding lactose in these cases. The lactose is hydrolyzed, and used by the dysentery bacilli and other organisms in the lumen of the alimentary canal. Under these conditions the dysentery flora becomes fermentative instead of putrefactive, that is to say, the flora (dysentery bacilli, *B. coli* and the streptococcus principally) form acid products instead of toxin and proteolytic products.

Some Quantitative Methods of Examining Fecal Bacteria: W. J. MACNEAL.

This paper is a summary of the methods employed in studying the fecal bacteria of healthy men already published in *The Journal of Infectious Diseases,* 1909, together with certain additions to the technic made since. The essential character in which the procedure is somewhat unique is in the plan of making every one of a large number of experimental results referable to a definite quantity of the mixed fecal flora, so that all the details of the comprehensive examination are quantitatively comparable with each other, and the results of one examination quantitatively comparable in detail with the results of another examination. The experimental observations fall under two heads: (1) the direct examination including (*a*) gravimetric determination of bacterial substance, (*b*) microscopic count of the bacterial cells by two methods and (*c*) differential count of Gram-stained fecal flora; (2) the culture tests including five different sets of plate cultures and one set of separation tube cultures of the mixed fecal flora, three different sets of plate cultures of the fecal spores and a variety of fermentation tube cultures devised not only to show differences in the fermentative activity of the mixed fecal flora, but also and more especially to bring to development and aid in the eventual isolation of various fecal bacteria which may not be found upon the plate cultures. For some of the results obtained by these methods those interested are referred to the papers cited above.

Tests of the Virulence of Diphtheria Bacilli: B. L. ARMS, M.D., and E. MARION WADE, B.A.

The paper gives the technic of the isolation and test and shows:

1. The marked variation in the virulence of different strains of diphtheria bacilli isolated from the same culture, showing the necessity of testing several strains before releasing a case on a negative virulence.

2. That as a rule if a case is proved positive by the virulence test the organisms retain their virulence as long as they persist, even though the case has completely recovered clinically.

3. That where there is an outbreak of diphtheria the "carriers" often harbor organisms, even though no symptoms are present in the host.

4. That sometimes the virulence may become enhanced, although this is the exception and seems to be more frequently true of institutional cases.

Further Studies on Blackhead in Turkeys: PHILIP B. HADLEY.

This paper presents some of the results of work on the blackhead disease of turkeys conducted at the Rhode Island Agricultural Experiment Station since July 1, 1908. The further investigations indicate that blackhead can not be considered as a specific disease, but that it includes several distinct etiological factors. One of these, as first reported, is coccidiosis. Another is now found to be infected with a species of flagellated organism. These two factors (and perhaps others) may work either together or separately to produce the pathological appearances characteristic of blackhead. Multiplication of the flagellates by means of spore-formation has been observed in the tissues of the ceca and liver. At an early stage of development many of the parasites lose their flagella and become ameboid. In the motile stage the flagellates are characterized by the presence of two flagella, a membrane and a short "Achenstab." The length of the motile forms does not exceed 12 μ. Encysted forms 12 μ–16 μ were observed. A more detailed report of the investigation appears in the *Centralblatt für Bakteriologie.*

Bacillary White Diarrhea of Young Chicks: LEO F. RETTGER.

The epidemic type of diarrhea which is characterized in part by a whitish diarrheal discharge, and which is now known as "bacillary white diarrhea," is caused by a bacillus which belongs to the coli-typhi group of bacteria. It has many

points in common with the typhoid bacillus. It may be cultivated easily on the ordinary laboratory media, but its growth on slant or plate agar is delicate, and very much like that of the *Streptococcus pyogenes*. This peculiar appearance on agar is a great aid in the identification of the bacillus, and hence in the diagnosis of the disease.

This organism, which has been named *Bacterium pullorum*, is present in the intestine, liver, lung, spleen, kidney, heart and unabsorbed yolk of chicks suffering with the disease in question. It is to be obtained most easily from the liver and yolk, when the latter is present.

Feeding experiments conducted on a large scale demonstrated that the disease may be transmitted to young chickens under three days old through infected food and drinking water. Furthermore, chicks may be infected with *Bacterium pullorum* before hatching. These two facts furnish an easy explanation as to the rapid spread of the infection among chicks many of which were normal at the time of hatching.

The mother hen is the source of infection in the egg. The examination of hens from which it was almost impossible to raise chicks, on account of white diarrhea, revealed the fact that the ovaries were infected with *Bacterium pullorum*. The diseased ova were very abnormal. They were discolored, misshapen and of all degrees of consistency. Eggs from these hens had been found to contain the specific bacillus in question in all stages of incubation. Later, a method was devised for identifying the bacillus in fresh eggs which came from infected flocks. Numerous eggs were tested, and the organism was observed in many of them. Thus, a satisfactory method is at hand for determining, without injury to the birds, which hens are infected with *Bacterium pullorum*, and consequently are the source of infection, if their eggs are used for hatching purposes.

Quite recently a pullet which was less than eight months old, and which was one of the survivers of an infected flock, showed the presence of the specific bacillus in the ovary. This discovery completed the cycle of infection. The laying hen is a bacillus carrier. Her eggs harbor the bacillus, and the chicks which are hatched emerge with the organism planted within them. These chicks are the source of infection of other chicks which are normal at the time of hatching. The disease becomes epidemic. The female chicks which survive carry the infection in their body until they are mature laying hens, and the same cycle is begun again, unless intelligent steps are taken to eradicate the infection by methods which are most apparent.

Carbolic Acid in Fowl Cholera: Philip B. Hadley.

The prevalence of fowl cholera in many of the New England states is increasing. An attempt is being made at the Rhode Island Agricultural Experiment Station to devise methods for its prevention or control. Preliminary experiments have involved a study of the effects of subcutaneous inoculations of a 5 per cent. solution of carbolic acid upon fowls previously infected with the organism of fowl cholera, *Bacillus bipolaris septicus*. The results of this work to date have shown that repeated daily subcutaneous inoculations with 5 per cent. carbolic acid, in 3 c.c. amounts, have power to prevent the development of the disease in fowls infected from one to twenty-four hours previously with the cholera organism. The results were approximately the same whether the infections resulted from subcutaneous inoculation of the virus or from the ingestion of virulent material (feeding by glass pipettes). The possible manner of action of the carbolic acid was discussed. A more detailed report of this work appears in Rhode Island Agricultural Experiment Station Bulletin, No. 144.

The Etiology of Contagious Abortion of Cows: W. J. MacNeal.

The existence of a contagious form of abortion in cattle has been recognized for a long time by practical husbandmen. Nocard (1886) made the first extensive bacteriological investigation of the disease, but failed to identify any microorganism as the cause. Bang (1896) found a small bacillus in the uterine exudate of aborting cows, grew it in pure culture, and produced abortion by injecting these cultures into cows and sheep. The peculiar oxygen requirement of the microorganism for growth in artificial culture was discovered and fully studied by Bang and Stribolt. Subsequently, the same organism has been isolated from cases of contagious abortion of cattle by Preisz (1902) in Budapest, Nowak (1908) in Krakau, McFadyean and Stockman (1909) in England, MacNeal and Kerr (1910) in Illinois, U. S. A., and by Zwick (1910) in Germany.

The microorganism is a very small rod, not motile and without spores. It is Gram-negative. Plate cultures are best obtained by streak inoculation on solidified serum-agar, the plates being incubated at 37° in a closed jar from which the oxygen is partly exhausted. This is conveniently accomplished by putting plates of *B. subtilis* in

the jar along with the cultures of the abortion bacillus. The appearance of the colonies is characteristic, and coupled with the behavior toward oxygen is almost sufficient for identification. Subcutaneous injection of active cultures into pregnant guinea-pigs causes abortion with great regularity.

Of the various names employed to designate the organism, *Bacillus* (or *Bacterium*) *abortus* Bang, is considered as the correct and appropriate one.

A Method for Determining the Germicidal Value and Penetrating Power of Liquid Disinfectants: ARTHUR I. KENDALL and MARTIN R. EDWARDS.

The method consists essentially of infecting plain agar with 24-hour cultures of *B. coli*, hardening the agar in sterile tubes of 1.5 cm. inside diameter and about 1 meter long, then cutting cylinders from the hardened agar by running it out slowly and sectioning it transversely into cylinders of about 2 cm. long with a sterile knife. The cylinders so obtained are dropped directly into the disinfecting solutions which it is desired to examine, and into 5 per cent. carbolic acid as a standard for comparison. Cylinders from each solution of disinfectant are removed at the end of stated intervals, washed in distilled, sterile water, and then a core removed from the center of each cylinder along the long axis by means of sterile quill tubing (3 mm. in diameter).

These cores so removed are placed in lactose fermentation tubes and incubated at body temperature for several days, making daily examinations for gas formation.

By comparing the results obtained with the various disinfectants with those of the standard carbolic acid, it is possible to formulate a coefficient which expresses the combined germicidal and penetrating power of the disinfectant in question with that of carbolic acid.

All abstracts have been supplied by authors unless otherwise stated.

CHARLES E. MARSHALL,
Secretary

EAST LANSING, MICH.

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 690th meeting was held on February 25, 1911, President Day in the chair. Two papers were read:

Some Causes of Variations in the Polarization of Sky Light: Dr. H. H. KIMBALL, of the U. S. Weather Bureau.

The first part of this paper contained a brief résumé of the main features of sky polarization, together with references to some of the theories that have been advanced to account for them. Observations by different investigators were cited to illustrate the character of periodic variations in sky polarization, and a summary was given of observations by the author. These latter include measurements of the percentage of polarization at the point of maximum, *i. e.*, 90 degrees from the sun and in its vertical, as well as observations on the position of the neutral points of Arago and Babinet. They show (1) variations in sky polarization with place, apparently due principally to differences in the intensity of reflection from the surface of the earth, and (2) variations with meteorological conditions.

No connection is apparent between sky polarization and the pressure exerted by the aqueous vapor contained in the atmosphere. Dustiness, or any form of mechanical haze, decreases the percentage of polarization; but by far the most potent cause of such a decrease appears to be optical haze, or the diffusion of light by reflection from the boundary surfaces of non-homogeneous layers or currents of air.

All of the observations included in the above summary were obtained when the sky was practically cloudless. Of the ten days on which the lowest percentage of polarization was observed seven were followed by rain before midnight of the succeeding day.

The Nature of the Sun: Dr. C. G. ABBOT, of the Smithsonian Institution.

In the preparation of a forthcoming book on the sun the speaker had attempted to explain solar phenomena on the hypothesis that the sun is completely gaseous, and not possessing the shell of clouds generally assumed to constitute the photosphere. The temperature of the sun seems to be of the order of 6500° absolute centigrade, and the pressure in the iron reversing layer about five atmospheres. In these circumstances it seems highly improbable that matter other than gaseous exists. A continuous spectrum was held by the speaker to be the natural consequence of the immense thickness and considerable pressure of the radiating gas sphere. A sharp boundary exists because the molecular scattering of light prevents the view at the center of the sun's disc from penetrating more than perhaps one thousand kilometers. A view at the sun's edge will be oblique, and to furnish gas one thousand kilometers thick

there will mean a thickness radially of only perhaps one hundred kilometers, which implies an indistinctness of outline of less than a half second of arc, which is not discernible. In consequence of the deeper source of the observed radiation the effective temperature of the source at the center of the sun's disc exceeds that at the sun's edge. Hence the intensity of the radiation falls off from the center to the edge. The diminution of the effective temperature of the source affects short wave rays more powerfully than longer ones, hence the contrast between edge and center is greater for violet than for red, as long known. The granulation of the sun's disc the speaker regarded as evidence of slight differences of temperature from place to place, with attending differences of radiation. He called attention to the fact that such differences of brightness appear most strongly in spectroheliographic photographs with the red hydrogen line, where of course it is out of the question that the effect is due to the precipitation of a cloud. But it is stated by some that the juxtaposition of the gases to empty space must necessarily cause a precipitation of a cloud by cooling. The speaker drew attention to the existence of water vapor without clouds in many regions of the earth's atmosphere, and to the existence of steam without a cloud for some distance above the stack of a locomotive. The question of cloudy precipitation depends upon the rate of supply of heat to take the place of energy radiated away, and on the rate of change of density of the gas at the boundary. A cloud is not a necessity. Many other points were discussed.

(The foregoing abstracts are by the respective authors of the papers.)

R. L. Faris,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 238th meeting of the society, held at the Cosmos Club on Wednesday evening, January 25, 1911, under informal communications, Mr. C. W. Hayes exhibited a series of specimens illustrating the growth of concretions of different composition under a variety of conditions.

(*a*) Calcite concretions from the famous Dos Bocas oil well, south of Tampico, Mexico. This well now forms a great caldron about 36 acres in extent. The ebullition due to the escape of gas, which a year ago was continuous, is now intermittent, having a period of about two hours. The well still yields a large quantity of hot (160° F.) salt water heavily charged with lime and a small amount of heavy oil in the form of a frothy emulsion. The water deposits lime carbonate partly in concretionary form. The concretions, from .5 to 1.5 inches in diameter, being kept in motion by the ebullition in the caldron are almost perfect spheres, made up of very thin concentric layers.

(*b*) Bauxite concretions from the Rome district in northwest Georgia. The formation of these deposits has been ascribed to hot-spring action and the conditions during their deposition were probably analogous to those seen in the Dos Bocas well. Instead, however, of being charged with lime in solution, the water contained aluminum hydroxide in suspension and this was deposited in concentric layers forming the bauxite concretions.

(*c*) Calcite concretions from San Antonio, Tex. These occur in great abundance in the "telpetate" or "caliche," a widespread chalky limestone formation, produced at or near the surface in semi-arid limestone regions by the ascent of water through capillary action and evaporation with deposition of the dissolved salts. Ordinarily the deposit has a platy structure, but in places, as at San Antonio, it is strongly concretionary.

(*d*) Bauxite concretions from the Little Rock district, Ark. These deposits are similar in form and possibly analogous in origin to the telpetate of San Antonio. The concretions are nearly indistinguishable from those of San Antonio, although entirely different in composition.

Regular Program

The Topographic Development of the Catskill Mountains: H. E. Merwin.

The Catskill Mountains and the adjacent region have the structure of a coastal plain with a very resistant thick member at the top. The Hudson-Mohawk valley developed as a subsequent valley in the weaker lower member that outcropped along the borders of the Adirondack-Taconic old land. The Hudson became superposed upon the complex structure of the Highlands which were buried beneath the coastal plain series. This river seems to have had its course well established by the close of the Paleozoic so that it was antecedent to the folded structure beneath and east of the Catskills.

The topography of the northeastern Catskills, though originally of the peak-and-spur type characteristic of mature plateaus, is now strongly influenced by the southward dip of the rocks. The drainage of this part of the Catskills was originally westward through the Delaware and Susque-

hanna rivers, but long after the uplift of the Cretaceous peneplain the Schoharie captured this drainage.

In the southern and western Catskills the streams are still working in massive rocks, developing the plateau type of topography.

The Iron Ores of Sweden: WALDEMAR LINDGREN.

Mr. Lindgren discussed nature and origin of the principal iron ore deposits and exhibited numerous specimens.

EDSON S. BASTIN,
Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

THE 71st regular meeting was held at the Cosmos Club, Tuesday, March 7, 1911, at 8:00 P.M. President W. J. Spillman presided. Thirty-two members were present. Mr. H. C. Skeels was elected to membership.

Mr. W. A. Orton discussed current dictionary definitions of the term "genetics" and showed that the usage attributed to Ward in the new Century is faulty, as that author proposed the term as an antithesis of "telics" and did not extend it to other phenomena of evolution. The usage in the new Webster was held to be faulty in that it does not convey the new view point of scientific experimentation. The term was thus newly defined: "*Genetics*—the application of scientific methods to the study of evolutionary problems; the investigation, in an exact manner and by experimental means, of the facts pertaining to heredity, variation and allied subjects."

The following papers were read:

Studies of the Life History of the Head Smut of Sorghum: ALDEN A. POTTER.

Attempts at preventing this smut by seed treatments have failed. Numerous inoculation experiments have been performed, but neither local infection, as in corn smut, seedling infection, as in the kernel smuts, nor floral infection, as in the loose smuts of barley and wheat, has been demonstrated. No theory of local infection can be entertained, however, since detailed histological study has shown that the host plant is affected as a whole. Since the infection is general, then, it must take place at an early stage.

Peculiar floral alterations were shown to be caused by the smut and to contain the smut mycelium, and it was suggested that some grains may develop with the fungus in them and the smut, therefore, be hereditary as is the fungus in certain *Lolium* species.

Dimorphic Leaves of Cotton and Allied Plants: O. F. COOK.

This paper reported the existence of a definite dimorphism of leaves in an Egyptian variety of *Hibiscus cannabinus.* The basal leaves are simple, but there is an abrupt transition to deeply lobed leaves near the middle of the stalk. A second Egyptian variety has all the leaves simple. Parallel variations of leaf-forms exist in cotton, okra and *Ingenhousia,* a wild relative of American upland cotton, found in Arizona and Mexico. The so-called okra varieties of upland cotton, with narrow-lobed leaves, correspond to the dimorphic Egyptian variety of *Hibiscus cannabinus.* Hybrids between okra cottons and broad-leaved varieties have shown intermediate forms of leaves in the conjugate generation and Mendelian segregation in the perjugate generation. Dimorphism and Mendelism were treated as analogous forms of alternative expression of characters, the current theory of alternative transmission being considered unnecessary.

Plant Remains Composing Coals: Dr. R. THIESSEN.

A brief review of the literature on the microscopic investigations of coals was given, in which the views of Bertrand and Renault and Potonié were dwelt upon.

Since every interpretation of any investigation must agree with every known scientific fact, in the present investigation on coal the structure, organization, morphology and chemistry of the living as well as of fossil plant forms had to be considered. Plant components of coals may be divided into two classes: those less resistant to chemical agencies, and those less easily or very difficultly attacked by such agencies. Among the latter class may be recounted the lignocelluloses, the true celluloses, the cuto-celluloses, especially the leaf cuticles, spore- and pollen-exines, the resins and the waxes. It has been found that the coals are composed in a large proportion, if not entirely, of this class.

The lignites are composed approximately of from 75 to 85 per cent. of stems, branches and twigs, almost entirely of coniferous origin, in a very much vertically compressed and changed condition, the interstices being filled in with a plant refuse, analogous to a recent black peat, in which resins, pollen-exines, spore-exines, cuticles and waxes form an important part. These constituting a crystalloid component are imbedded in a colloidal substance, mainly a derivative of cellulose. Here as in all the coals, nothing but the outer wall or

exine of the spore- and pollen-grains is now left, and of the leaves nothing but the cuticle, rarely the epidermis, is left.

The brown-coals from Lester, Ark., are composed of a "débris" only, in which the crystalloid components form a very large proportion; fern spore-exines also are very abundant. To these constituents must be ascribed the oil-yielding properties of this coal.

In the bituminous coal from Exeter, Ill., the "wood" is represented mainly by thin, jetty, black, lamina, between which is found a component closely resembling the débris of the younger coals, having as a ground substance a much macerated woody or colloidal material in which a greater proportion of crystalloid substances are imbedded. All the elements found in the younger coals and also megaspores are represented. The bituminous coal from Shelbeyville is very similar but has a much greater proportion of crystalloid material, megaspore-exines and cuticles.

The cannel coals examined are composed almost entirely of spore-exines of a variety of forms; resins and cuticles are present only in a very subordinate amount. The so-called binding matter in the interstices of the spore-exines is distinctly composed of two kinds of substances, one more or less homogeneous, colloidal in nature, and the other more or less granular, the fragmentary residue of spore-exines.

The algal theory of Bertrand and Renault, and the sapropellic theory of Pontonié were rejected as being undemonstrable in every particular. The bodies supposed to be algæ can be shown not to be algæ, and all but one kind have unmistakably been proved to be the exines of certain spores, either of Pteridophytes or Cycadofilicales or both. A gelosic substance, such as the algal theory calls for, is entirely absent.

W. W. Stockberger,
Corresponding Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

At the 452d meeting of the board of managers, held March 23, 1911, the following resolutions submitted by the undersigned committee were adopted by the board and ordered published in Science:

"Acting on the information furnished by one of its members, Dr. Aleš Hrdlička, in regard to the wholesale destruction of antiquities in all parts of Peru, as well as in other regions of South America, the Anthropological Society of Washington has, after due consideration, resolved that:

"1. The remains of American aborigines, wherever met with, and particularly in such countries as Peru, where native civilization reached high standards, are historical records of definite branches of the human family and, as such, are of great value to science, to the country in which they exist and to mankind in general.

"2. In view of such value of the remains in question, which include all manifestations of human activity, and also the associated skeletal parts of man himself, the destruction of these records is deprecated and the hope is expressed that scientific men and societies, as well as the proper authorities, will counteract the same as far as possible."

W. H. Holmes,
A. Hrdlička,
Walter Hough,
Committee
I. M. Cassanowicz,
Secretary

THE AMERICAN PHILOSOPHICAL SOCIETY

Dr. F. M. Jaeger, professor of inorganic and physical chemistry and head of the department of chemistry in the University of Gröningen, Holland, gave an illustrated lecture "On Fluid Crystals and Anisotropic Liquids" before the American Philosophical Society on March 3. He explained why this question was one of the most ardently discussed problems of physical chemistry at present; how the old conception as to the molecular movement of the liquid state can not hold in the face of the newly discovered facts. He pointed out the close analogy between these phenomena and the polymorphic changes of matter and discussed the properties of substances melting successively to two, three or more liquid states. He demonstrated the principal physical properties of the above substances, their birefringence, magnetic induction, surface-tension and circular polarization. He discussed the so-called "emulsion theory" and proved its valuelessness for the explanation of the different phenomena.

In short, it is proved now undoubtedly that liquids can share the characteristic properties of crystalline matter and that they display phenomena which indicate a regular molecular movement in the liquid state. The whole subject is of the highest importance both for physics and for chemistry.